AVIATION WEEK
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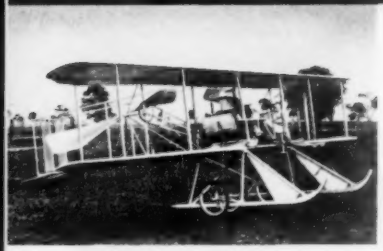

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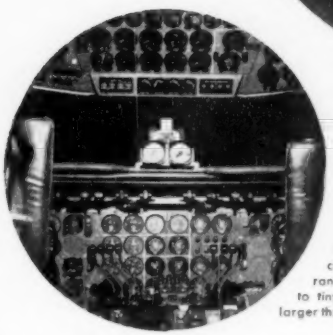

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Aviation Week

ABP Member ABC

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Look what's new in AIR VALVES

A few of the 225 types — *no two alike* — tailored for aircraft by AiResearch

Shown here are a handful among the latest advances in air valve design pioneered by AiResearch.

Valves such as these automatically control air and gas flow in today's jet and turbo prop aircraft. AiResearch designs meet every conceivable application. Now in production are valves entirely of stainless steel which handle temperatures up to 1000° F. . . valves 6" in diameter which open and close fully within .05 seconds. . . butterfly valves with less than .05 pounds per minute leakage at 100 PSI.

Typical new applications are mixing valves for mixing combustion gas and bleed air, also an advance design pressure ratio sensing valve for unloading gas turbine compressors.

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MUSICK MEMORIAL TROPHY

"...most effective in furthering the safety of aircraft..."

The Musick Memorial Trophy, known throughout the world of aviation, is for annual award "to the group, body or individual that has recently made the contribution, development or improvement which by its practical application has become most effective in furthering the safety of aircraft with special reference to transoceanic aviation, or directly so by increasing the efficiency of aircraft."

The Trophy was established in 1938 by citizens of Auckland, New Zealand, in memory of Capt. Edwin C. Musick and his six companions in the "Samoan Clipper" who were lost in the South Pacific on January 12, 1938 while making the first commercial flight from the United States to New Zealand.

For its contribution in furthering the safety of transoceanic aircraft, the Sperry Engine Analyzer has recently won the Musick Memorial Trophy for 1951. This award was made to *John E. Lindberg, Jr.* and *James W. Wheeler* who jointly developed the Analyzer. At the time of this development, Lindberg was a staff engineer in the Pacific-Alaska Division of Pan American World Airways and Wheeler was head of the engine instrument department of the Sperry Gyroscope Company.

Acclaimed for its contributions to flight safety, the Analyzer is in wide use on commercial and military planes throughout the world. It immediately detects, locates and identifies detailed ignition and mechanical troubles in aircraft power plants either during flight or on the ground.

Sperry Gyroscope Company
Division of The Sperry Corporation
Great Neck, New York

NEWS DIGEST

Domestic

Minneapolis-Honeywell says that its new E-11 automatic pilot, slated for use on the new twin-jet Douglas RB-66, is also designed for use on interceptors where it can automatically guide the plane to the target, acting from signals provided by the plane's radar and computer. M-H says it has orders for E-11s for use on the RB-66 (as reported in AVIATION WEEK Sept. 19) but mentions no possible fighter or interceptor application. The E-11 is reported under consideration for use on the new McDonnell F-101.

Joseph Adams, Civil Aeronautics Board member, has been appointed by the President to succeed former CAB Chairman Donald Nyrop on the National Advisory Committee for Aeronautics (NACA).

Flight Refueling, Inc., Danbury, Conn., will come under the control of an American group which includes Reaction Motors, Inc., Rockaway, N. J., Laurance S. Rockefeller, New York, and associates, according to an agreement transferring controlling interest from Flight Refueling, Ltd., Dorset, England. The agreement is subject to stockholders' approval and other conditions.

William P. Person has been appointed manager of the Air Transport division of the Flight Safety Foundation.

Aircraft Industries Assn. of America reports 252 personal and executive aircraft were shipped during the month of October, including 210 four-place or larger and 42 one- and two-place planes. Value was given as $2,624,000.

Sir Geoffrey de Havilland was presented with the Daniel Guggenheim medal "for 40 years of pioneering in military and commercial aircraft and the development of long-range jet transport" at the annual banquet of American Society of Mechanical Engineers at the Statler Hotel, New York, last week.

William Littlewood, vice president-engineering, American Airlines, will give the sixteenth Wright Brothers lecture Dec. 17 in Washington, discussing "Technical Trends in Air Transportation."

Eastern Air Lines Constellation flight engineers last week went on strike, crippling much of the carrier's operations. Walkout resulted from a pay dispute and disagreement over a new contract. Only EAL Connies were grounded since flight engineers are not used on other company planes.

ATTENDING SAFETY MEET sponsored by Flight Safety Foundation in Bermuda recently were (left to right): Arthur Jenks, CAA; Herbert Fisher, Port of N. Y. Authority; David Little, American Airlines; Capt. P. P. Cocquyt, Sabena Airlines, an FSF award winner; Capt. Vernon Peterson, and Clarence Saven, president of ALPA.

Selig Altschul, independent aviation consultant and contributing financial editor of AVIATION WEEK, delivered the aviation lecture at the New York Institute of Finance for the fourth consecutive year. He discussed airlines Nov. 20 and the aircraft group Dec. 4. The institute is affiliated with the New York Stock Exchange.

Financial

Northwest Airlines reports net income after taxes of $349,965 for the month of October. Net income for the first 10 months of 1952 was $1,312,599 from total revenues of $46,333,180.

Northrop Aircraft has declared a regular quarterly dividend of 25 cents a share payable Dec. 17 to stockholders of record Dec. 3. Net income after taxes for the three-month period ending Oct. 31 was $1,592,993, including income from Radioplane Co., a wholly owned subsidiary. Backlog as of Oct. 31 was $422 million.

Solar Aircraft Co. reported net income for the six-month period ending Oct. 31 of $1,739,700. Unfilled orders exceeded $92 million.

Sundstrand Machine Tool Co. has declared a 5% stock dividend in addition to a regular quarterly dividend of 30 cents a share, both payable on Dec. 20 to stockholders of record Dec. 10.

Elastic Stop Nut Corp. of America has declared a dividend of 30 cents a share payable Jan. 5 to stockholders of record Dec. 15, and an additional dividend of 25 cents payable Feb. 2 to stockholders of record Jan. 15.

International

Hawker Siddeley Group, Ltd., will soon have in production an improved version of the Double Mamba turboprop engine. The new axial-flow unit, known as ASMD3, has a takeoff rating of 3,125 hp. and consists of two side-by-side engines. Designed for use in the Fairey Gannet, H-S says it will run on Diesel oil, kerosene, "wide cut" turbine fuel, or any mixture of the three, with a fuel consumption of 274 gal./hr.

British Overseas Airways has under consideration a civil version of the new Avro delta-wing 698 Vulcan.

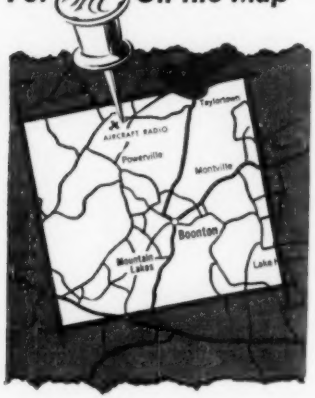
British European Airways soon will take delivery on the first of 26 Discovery-class turboprop airliners, recently certificated by the Air Registration Board. A second production Discovery is about ready for flight tests.

First A. V. Roe-built Canberra bomber made its first flight Nov. 25, two years and two weeks after the firm commenced production.

The Canadian Department of Defense Production ordered aircraft equipment, spares and overhaul totaling $2,187,500 during the first half of November. Largest order ($522,500) went to Canadair, Ltd., Montreal, for engine maintenance stands.

Consistent QUALITY...

Put ARC On the Map



On air map or road map of New Jersey, you will see the name "Aircraft Radio" marking our location just N.N.W. of Boonton.

Names don't appear on the map overnight. It takes stability and reputation. And as we approach our 25th anniversary, it is gratifying to know that A.R.C. has been "put on the map" in another sense, too. All over the world, A.R.C. is known and our communications and navigational instruments are widely used and trusted.

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BOONTON NEW JERSEY

AVIATION CALENDAR

Dec. 12—Second Convertible Aircraft Congress, The Franklin Institute, Philadelphia.

Dec. 17—Annual Wright Bros. dinner, 7:30 p.m., Statler Hotel, Washington, D. C. Wright Bros. lecture to be presented by IAS 3 p.m., U. S. Chamber of Commerce auditorium.

Jan. 12-16—Annual meeting and engineering display of Society of Automotive Engineers, Sheraton-Cadillac Hotel, Detroit.

Jan. 14-16—AIEE-IRE-NBS Conference on High Frequency Measurements, Statler Hotel, Washington, D. C.

Jan. 15-16—Fifth Illinois Custom Spray Operators Training School, University of Illinois, Urbana, Ill.

Jan. 19-23—Plant Maintenance Conference, Public Auditorium, Cleveland, O.

Jan. 19-23—Winter general meeting of the American Institute of Electrical Engineers, Hotel Statler, New York, N. Y.

Feb. 18—New York Section of the Instrument Society of America, Hotel Statler, New York, N. Y.

Feb. 18-19—Eighth Annual Society of the Plastics Industry, Reinforced Plastics division, conference, Shoreham Hotel, Washington, D. C.

Mar. 10-11—Eleventh Annual Conference, Society of the Plastics Industry Canada, Inc., General Brock Hotel, Niagara Falls, Canada.

Mar. 25-27—National Production Forum of the SAE, Hotel Statler, Cleveland, O.

Mar. 31-Apr. 2—First International Magnesium Exposition, National Guard Armory, Washington, D. C.

Apr. 4-12—Second Annual International Motor Sports Shows, Grand Central Palace, New York, N. Y.

Apr. 20-23—Aeronautic Production Forum, National Aeronautic Meeting and Aircraft Engineering Display (SAE), Hotel Governor Clinton and Hotel Statler, New York, N. Y.

May 11-13—IRE National Conference on Airborne Electronics, Dayton Biltmore Hotel, Dayton, O.

May 18-22—Fifth National Materials Handling Exposition, Convention Hall, Philadelphia.

June 9-11—Second International Aviation Trade Show, Hotel Statler, New York, N. Y.

Oct. 10—International Air Race, England to Christchurch, N. Z., entry deadline Jan. 31.

Sept. 7-13—1953 SBAC Coronation Year Flying Display, Farnborough, Hampshire.

Sept. 14-17—Fourth Anglo-American Aeronautical Conference, London.

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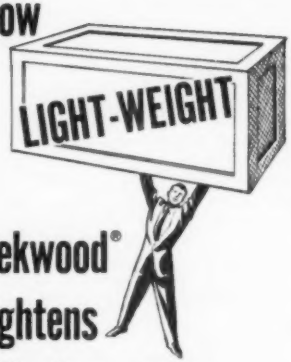

Tekwood is *light* yet it's *strong*.

Its remarkably high strength, low-weight ratio (due to its kraft paper-and-hardwood plywood-type construction) means you can ship with less weight at lower transportation costs. Strong, tough Tekwood also gives more protection for your aircraft parts.

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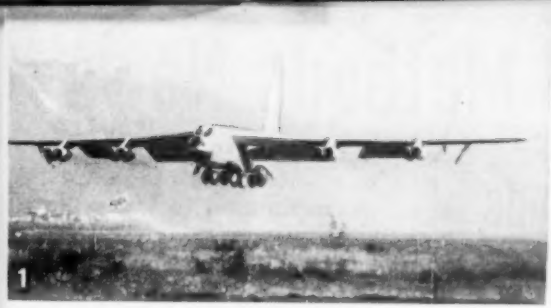
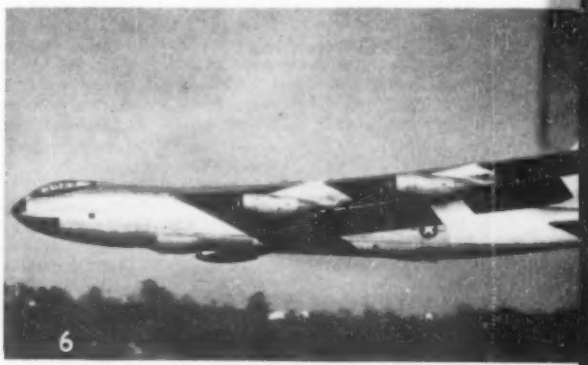
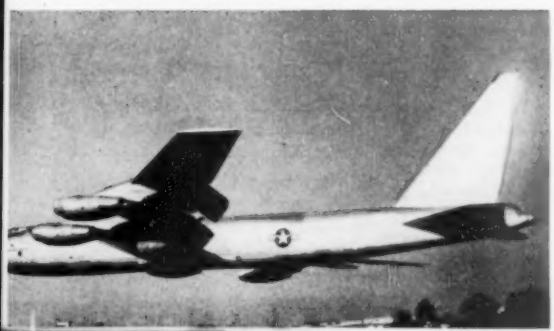


Boeing YB-52 Stratofort Heads 'Upstairs'

With its eight powerful P&WA J57 split-compressor turbojets roaring, the mighty Boeing YB-52 Stratofortress takes off from Boeing Field, Seattle, Wash., on one of its numerous flight tests. This unusual photo sequence gives the reader the impression he is standing near the runway as the plane gets off the ground, gradually tucks in its eight main wheels and two outriggers, and then flashes past him into the sky. The lack of a smoky engine exhaust is noteworthy. USAF has ordered the Boeing bomber into production at Seattle.





Remington Rand Methods News

Let's talk control methods at Cleveland Maintenance Show

Many types of effective records for maintenance control can be studied at Booths 507 and 511, Public Auditorium, Jan. 19-22

For profitable new approaches to the record-keeping problems of a maintenance department, there's nothing like seeing how other firms get results. Also, at the Maintenance Show, we will introduce to you a new idea or two in maintenance control — demonstrated for the first time anywhere.

And, naturally, we will show you many of the production and materials control methods described in our manual X-1268. If you can't visit with us in Cleveland, be sure to send coupon below for helpful literature on subjects of interest to you.

Look to your preventive maintenance record for help in keeping plant output at peak

As production equipment grows more complicated, a breakdown becomes more costly. Preventive maintenance control is more vital than ever for plant efficiency. Your records must help *prevent* the failures — or else!

Maintenance superintendents who have a healthy hatred for paperwork always like our simplified visible methods which give maintenance *control* with minimum clerical work.

These methods visually signal the next inspection date for *every* piece of equipment; tell what inspection is needed; permit scheduling of work ahead. Every man's time can be planned for maximum efficiency. Maintenance work loads can be stabilized.

Also, these methods eliminate the guesswork on proper interval between inspections. Decisions can be made on the basis of actual experience for each type of equipment.

Likewise, the records help fix responsibility for an unnecessary breakdown; revealing whether the failure was due to operator abuse or careless maintenance work.

The plant engineer gets all the facts for determining when it will pay to replace a part or machine. He has a complete and convenient history of servicing and repair costs, as well as depreciation on the equipment.

These methods are flexible; can be adapted to your own special needs. See how they have been tied in with preventive maintenance manuals; adapted to special types of equipment such as electric motors; etc.

Study the procedures and methods, as well as preventive maintenance and property records used successfully in many well-known plants. Ask for folders **KD-656** and **KD-705**, also for methods file **MC-727** which is available on a ten-day loan.

Get better maintenance from smaller inventory

There's a firm of 2,000 employees operating on a total maintenance inventory of only $30,000 *which turns over at the rate of nine times a year.* What's more, they don't have to worry about running short of any part or material needed to keep the machines running.

This achievement was made possible by centralizing the inventory records and the purchasing of maintenance supplies under a control system which Remington Rand designed and installed.

Previously, individual department heads had done much of their own buying. This led to wasteful duplication of stocks. Likewise, they passed up the valuable savings of volume buying because each plant bought from its own sources. Nor could they get the service which comes with planned buying.

Previously, an entire department might be shut down for lack of a single part in the stockroom when it was needed. Now the stocks cannot fall below a safe minimum on any item without management knowing about it.

Let us show you how such a system can work for small plants or large — with minimum paperwork. Ask for our new methods file **MC-802.**

QUICK RELIEF FOR COMMON MAINTENANCE HEADACHES

A small part can give you a big pain — when it's the wrong part. Poor description of parts and materials brings all kinds of trouble: shortages and repair delays, duplications and overstocks. But the cure is simple. Identify and classify each item properly, so it can be referred to by exact number at every step from purchasing to costing. See how our engineers have helped other firms accomplish this at minimum cost. Ask for booklet **BSD-10.**

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MC-727 MC-802 BSD-10

Name_____
Title_____
Firm_____
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City_____

P-8

WHO'S WHERE

In the Front Office

George R. Hill has been named a vice president of Curtiss-Wright Corp., Wood-Ridge, N. J. He will continue his duties as controller, a post he has held since 1949.

Gen. Russell E. Randall has been appointed president of Air America, a nonsked carrier having offices at Lockheed Air Terminal, Burbank, Calif. Gen. Randall's aviation background goes back to 1925. He was in the Air Force from then to November 1949 when he retired.

Arthur H. Kuljian has been designated vice president-engineering for the Kuljian Corp., Phila., Pa., structural engineers for the USAF and industry.

Hugh Lehnacker and **Julius Kendall** have been elected vice presidents of Greer Hydraulics, Inc. Lehnacker will continue in charge of production for aviation industrial test equipment and all hydraulic components. Kendall will continue as general sales and service manager and will direct the Research and Development division. **David Fromson** has been named contracts manager and administrative assistant to the treasurer.

Humphrey W. Toomey has been elected a vice president of Pan American World Airways, with headquarters in Rio de Janeiro. Manager of the Latin American division since 1946, Toomey will be succeeded in that post by **Edwin Drescher.** In another executive move, **Harold E. Gray,** vice president of Pacific-Alaska division, has been elected vice president of PAA's Atlantic division. **Vice President Clarence M. Young** has succeeded Gray in the PAD post.

Changes

John Roberts has been designated engineering manager for Pastushin Aviation Corp., Los Angeles.

Robert V. Woodworth has been appointed general sales manager for the Flying Tiger Line. His previous post as manager of the rates-tariff section has been filled by **William A. Staley. Mayo Thomas** has been assigned to combined functions of international, agency and international sales.

Frederic H. Holt has been named manager of marketing for General Electric Co.'s Control department at Schenectady, N. Y. **James W. Cooke** has been appointed manager of engineering in this section.

Joseph B. Rice, Jr., has been designated general manager and chairman of the board of Beckman & Whitley, Inc., San Carlos, Calif., maker of meteorological and special instrumentation and ballistics cameras.

Honors and Elections

Vice Admiral Emory S. Land has been awarded the Vice Admiral "Jerry" Land medal, a new honor given for the first time this year by the Society of Naval Architects and Marine Engineers. The medal was presented to Adm. Land for his accomplishments as chairman of the old maritime commission and of the War Shipping Administration.

INDUSTRY OBSERVER

► **Convair officials may not know it yet but a production contract is being processed at Air Materiel Command Headquarters for a sizable number of multi-jet supersonic bombers to be built in Convair's Ft. Worth plant. USAF order for the Convair supersonic bomber confirms earlier hints on the subject by Undersecretary Roswell Gilpatric, who last August said "other essential work" would be scheduled for the Ft. Worth plant in "substantial" quantity when B-36 production phased out there in 1954 (Aviation Week Aug. 4, p. 69). Boeing was the Convair competitor for the supersonic bomber contract.**

► General Motors Corp. officials are pleased over the recent CAA proposal to include flight testing of their Allison division Turbo-Liner in its proposed fiscal 1954 jet transport program. Part of CAA's proposed $1.5-million budget request to develop test and safety data for jet airliners is an item for 75 hr. of safety flight testing the Turbo-Liner at $1,600 an hour and another 75 hr. of operational flight testing at $1,000 an hour. The Turbo-Liner is a Convair 240 airframe powered by two Allison T38 turboprops.

► **Watch for an expansion of Flight Refueling, Inc., of Danbury, Conn. Both USAF and Navy are counting heavily on its "probe and drogue" method of refueling in their future operational plans. Rockefeller capital probably will be invested to expand operation of the small Connecticut firm to meet military production requirements. Latest test of the equipment has been in a Convair B-36 modified as a tanker to refuel Boeing B-47 bombers in flight.**

► Bitter controversy between United Air Lines and most of the other large U.S. airlines on the issue of high- vs. low-density seating is being carried over into the jet transport field. UAL is the sole holdout against high-density seating for U.S. jet transport designs. All other airlines seriously interested in operating jet airliners are pressing for increased seating capacity as the key to profitable jet transport operations. Since UAL is a large equipment buyer, U.S. aircraft manufacturers are reluctant to ignore its demands.

► **Experiments with prone piloting in a modified Lockheed F-80E by USAF and the Stanley Aviation Co. of Buffalo have proved that pilots lying prone can operate at zero gravity conditions for as long as 20 sec. with no ill effects. Interest in prone piloting still is extremely high because of the advantages it offers in solving the difficult canopy problems of aircraft at speeds of Mach 1.5 and above.**

► Both the Vickers transport version of the sweptwing Valiant bomber and Avro's civil airliner based on the delta Vulcan bomber configuration are being aimed at a capacity of about 150 passengers. Sir Roy Dobson, Avro chief executive, claims the jet airliner version of the Vulcan could make three roundtrips a day between New York and Prestwick with 150 passengers. BOAC is studying Vulcan transports.

► **American Export and Import Co. of Miami has signed a USAF contract to fly R4360-53 piston engines from the Pratt & Whitney Aircraft factory at East Hartford, Conn., to Convair's Ft. Worth plant in its C-46 fleet. The 3,800-hp. piston engines are used in the latest models of the B-36 bomber. On return flight from Ft. Worth AEXICO will haul aircraft parts from Tinker AFB (Oklahoma City) to Westover AFB, Idlewild or Newark. Contract calls for a minimum of 50,000 air transport miles a month with a maximum not over 95,000 miles.**

► Ryan Aeronautical Co. has received its second contract for research and development on titanium applications for aircraft structures. Latest contract from the Navy calls for manufacture and testing of a large number of typical aircraft structural parts made of titanium. Earlier USAF contract was for titanium processing methods suitable for application to aircraft engine exhaust systems.

Washington Roundup

Money Picture

Here is what to expect in contract letting and spending for aircraft and related procurement:

► **A slight letup in Air Force contracting.**

• USAF contracting has been going forward at a high rate. During the first four months—July to November—USAF obligated $5.8 billion or almost half of the $12 billion it has available for the 1953 fiscal year.

• This means that USAF has only $6.2 billion left for contract letting over the eight months from November to the end of the year, July 1.

► **A substantial increase in BuAer procurement contracts.**

• The lag in Navy's aircraft procurement program continued through October. The $36 million obligated in that month compared with $239 million in October 1951.

• During the first four months of the current fiscal year—July to November—BuAer contracting averaged only $194 million a month.

• The rate will have to be stepped up to an average $340 million a month over the eight months from November through June, if BuAer is to use up all the $3.5 billion it has available for plane and related procurement for this fiscal year.

• Unless the rate is sharply stepped up soon, the BuAer program faces difficulty. Congress has barred contract letting during May and June at a rate higher than 125% of the average for the 10 preceding months. Its purpose: to prevent a mad race by government agencies to unload funds to get more for the next fiscal year.

► **A big increase in spending—or actual money payments—for aircraft.**

• The 1953 fiscal year program calls for an expenditure of $9.5 billion for aircraft and related procurement by USAF and BuAer.

• But only $2.3 billion was spent during the first four months—July to November.

• This leaves $7.2 billion to be spent over the next eight months.

• If it isn't spent, the services are in for some congressional criticism. They protested that a ceiling on spending would mean deliveries of planes and other equipment would have to be slowed down. Congress reluctantly lifted the ceiling. But apparently the services aren't able to spend money scheduled for aircraft procurement payments anyway.

Eisenhower on Defense

President-elect Dwight Eisenhower put down these two basic concepts for U. S. defense policy in congressional testimony a year and a half ago:

U. S. self defense requires "holding" the land area of Western Europe. This means maintenance of a large tactical air force by the Allied nations.

His observation: "In Western Europe exists a great industrial fabric that is second in its capacity only to that of our nation. If we take that whole complex with its potential for military exploitation and transfer it from our side to another side, the military balance of power has shifted so drastically that our safety would be gravely imperiled. The significance of the Western European group of nations is even greater than that. They have with many areas of the world close blood, political and economic ties. It is scarcely possible to imagine the fall of Western Europe to Communism without the simultaneous fall of certain of these great areas, particularly those, and first those, areas which have a political dependence upon the European power, the very areas from which we draw the materials which are absolutely essential to our existence—manganese, copper, uranium, for example."

Otherwise, "mobility"—ability to meet aggression in any direction—is the key to U. S. defense. This means air power to keep control of the sky and sea lanes.

Eisenhower's comment: "I believe two things: First, that our great strength lies in our central position with our ability to move in the directions that we see require it. Therefore, we must capitalize on sea control. We must have great air power, not only interceptors but planes to protect the sea lanes and carry us forward. I have the idea that we recognize a special relationship between ourselves and Western Europe, and that we must take whatever steps are necessary cooperatively to assure our common defense.

"Otherwise, I say that our special strength is this mobility and being in this central position."

Democratic Supporters

As in 1948, Washington attorneys handling airline accounts were among Democratic National Committee's most generous financial supporters.

The committee reports these contributions received from June 1 to Oct. 29:

Paul Porter of Arnold, Fortas and Porter, representing PAA, $500.

John L. Sullivan and John Shea, of Bernard, Sullivan and Shea, which have represented the regional air carriers on airmail subsidy separation legislation, $1,000 and $100, respectively.

Homer Cummings, former Attorney General, of Cummings, Stanley, Truitt and Cross, which represents National Airlines, $1,100.

L. Welch Pogue, former CAB chairman, of Pogue and Neal, which represents Western Air Lines and Alaska Airlines, $1,300.

Millard Tydings and Alfons Landa, of Davies, Richberg, Tydings, Beebe and Landa, which represents Freight Air, Inc., Seaboard and Western, and Colonial Airlines, $4,000 and $250, respectively.

Clark Clifford, who handles TWA and Panagra business, $1,000.

John Carmody of Whiteford, Hart, Carmody and Wilson, counsel for Braniff Airways, $300.

William M. Boyle, former chairman of the Democratic National Committee, who handled a United Air Lines account valued at $30,000, $1,250.

Louis Johnson, counsel for PAA, $1,000.

Others prominent in aviation who were listed among Democratic contributors: Robert Six, president, Continental Airlines, $1,000; Jack Frye, former TWA president, $2,500; R. S. Reynolds, president, Reynolds Metals Co., and wife, $3,500; Arthur Christie, Washington representative, Pratt & Whitney Aircraft, $100; Thomas Bourne, former head of CAA's airport program and now Washington airport consultant, $500; Donald Nyrop, former CAB chairman, $100; J. Carroll Cone, PAA assistant vice president, $2,000; Russell B. Adams, PAA vice president, $200.

—Katherine Johnsen

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UAL Presents Case Against Coach Seating

- **Patterson's attack on safety rocks industry.**
- **CAA holds closed-door session to hear story.**

By Lee Moore

United Air Lines President W. A. Patterson carried his case against high-density aircoach seating to Civil Aeronautics Administration and Civil Aeronautics Board in Washington last week. Patterson, armed with movies of simulated crash emergency evacuation operations, told CAA Administrator Charles Horne that the high-density seating—necessary for low aircoach fares—is a "safety hazard."

Patterson presented his case in a three-hour session behind closed doors before an audience consisting of Horne, CAB Chairman Oswald Ryan, CAB members Chan Gurney, Josh Lee and Joseph Adams and their technical staff.

CAB members were present at the session only as observers since any formal proposal for a change in air safety regulations such as proposed by Patterson would require public CAB proceedings.

The transport industry—airline and government—was stunned by Patterson's sudden condemnation of coach safety standards in his communiques to CAA and CAB, and in his nationally distributed press release that branded coach seating as a "safety hazard."

▶ **Horne Answers**—Charles Horne, to whom Patterson addressed his main attack, answered by congratulating Patterson on his "commendable desire to provide a higher degree of evacuation safety than that required by existing regulations."

CAB members and staff, as well as airline officials, privately told AVIATION WEEK that they interpret Patterson's sensational challenge as a move to vindicate in his own mind his former claim—now disproved and rejected by the rest of the industry—that aircoach would not pay. Reducing the seating capacity, as he has now done, will make sure it won't pay at present coach fares, airline and CAB officials say.

Airline executives were reticent to comment for the record, however. They fear that public debate may scare many prospective coach customers and induce congressmen to call for lower seating densities. One airline official told AVIATION WEEK, "We feel that the less said about his calling other airline operations unsafe the better."

▶ **Safety vs. Price**—Patterson's first curt telegram to CAA and Administrator Horne's reply mentioned safety only. But in a separate letter sent to CAB, Patterson hinted at the major consideration governing coach seating—the economics of one-fourth to one-third lower price through "crowding" more passengers in.

Patterson's letter implied that the airlines and CAB have been blind in moving as rapidly into coach as they have. "The airlines," he wrote, "are trying to outdo one another . . . overlooking safety. . . ." He said that it would be "most detrimental to our industry if there is not a 'stop, look and listen' attitude toward this campaign toward coach service, which has been going on now for several months."

He added: "To us (United) this entire situation is a most serious one. There has been pressure for the expansion of aircoach service."

In addition to his tests on emergency exits, Patterson wrote CAB that

Aircoach Seating

Plane	Airline	Maximum Coach Seats	Passengers Per Exit
DC-4	Capital*	60	12
	Eastern*	68	14
	National	69	14
	Northwest	66	13
	TWA	60	12
	United (New)	54	11
	North American**	79	16
DC-6	American***	80	11
DC-6B	Pan American	82	7
Constellation	Eastern*	60	9
	TWA	81	12
Super Connie	Eastern*	88	10
Stratocruiser	Pan American	80	7
C-46	Most Nonskeds	45-50	11-12

Maximum Allowed by CAB****

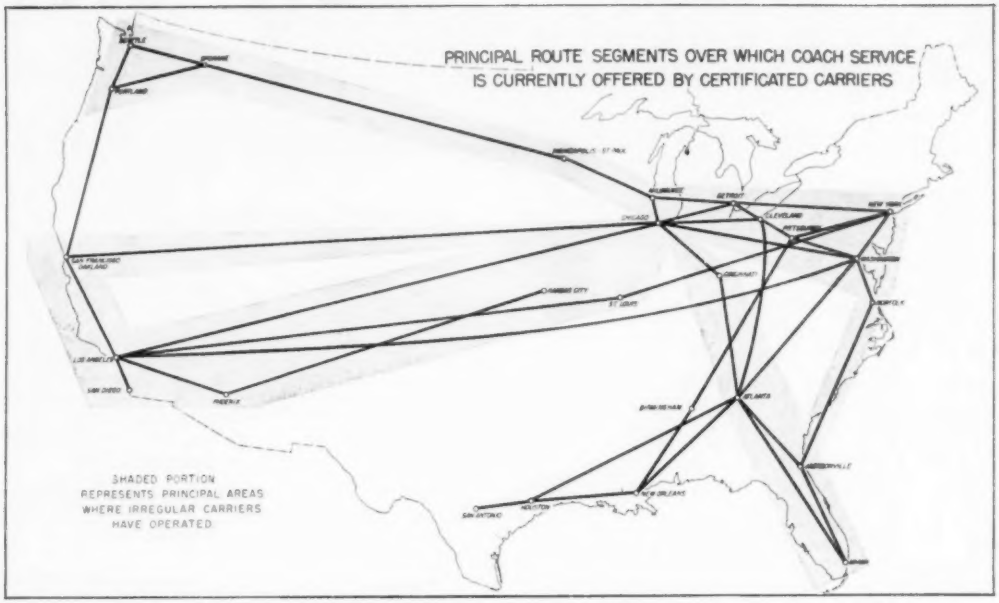
	Occupants Authorized (Incl. Crew)	No. Exits Auth. for Passenger Use	Men Per Exit
DC-4	86	5	17
C-46	67	4	17
DC-6	87	7	12
Constellation	87	7	12
Super Connie	96	9	11
Stratocruiser	96	9	11
DC-6B	112	11	10

* Eastern and Capital use the same planes for first-class and coach service, EAL on DC-4 and Connies, Capital on DC-4 only.

** North American is the largest nonscheduled airline operation.

*** American is converting its existing DC-6 coaches from 70 to 80 passengers, and is converting some standard DC-6s to 80-passenger coaches.

**** CAB Special Regulation No. 387, issued 1952.


PRINCIPAL ROUTE SEGMENTS OVER WHICH COACH SERVICE IS CURRENTLY OFFERED BY CERTIFICATED CARRIERS
SHADED PORTION REPRESENTS PRINCIPAL AREAS WHERE IRREGULAR CARRIERS HAVE OPERATED

High-density coach seating of scheduled and nonscheduled airlines has brought 25-33% lower fares to most major, will reach all soon.

"we have the opinions of two independent authorities whose views would be most detrimental to our industry" unless coach expansion is slowed down.

One of these two authorities is presumed to be the Cornell Aeronautical Laboratory, which conducted his tests under private contract. However, Cornell immediately denied that it had made a qualitative judgment of this sort.

• **Tests.** And both Air Transport Assn. engineer Al Dallas and CAA aeromedical design chief Dr. Barry King said the Cornell tests showed about the same as previous tests and studies by CAB, CAA, airlines and Military Air Transport Service. CAB safety regulation official Witold E. Konieczny said tests indicate that it would take three minutes to evacuate a DC-4 coach with an average passenger load. However, he pointed out that no tests could actually duplicate an emergency and that emergency conditions vary greatly.

• **Regulation.** CAB had decided on the present regulation after balancing safety vs. economics, as it must in every safety regulation. CAA had already given permission to one operator to carry over 100 passengers on special DC-4 flights for migratory workers. That was too high, CAB decided. But at the other extreme, maximum passenger safety could only be obtained with a payload limited to one person.

Since the DC-4 is an old design, CAB had to be tolerant in establishing "retroactive" limits on its payload. The Board decided on a maximum occupancy of 86 persons, giving a ratio of 17 persons per exit. The Board's regulation is progressively more stringent on newer aircraft (see box, p. 13), as is its custom in retroactive safety regulation. Designers and buyers of the postwar DC-6 and Constellation had been warned to provide more exits, so CAB has brought their maximum man-per-exit ratio down to 12. On their recent modifications—DC-6B and L-1049—the ratio is still lower.

Besides the retroactive leniency in safety regulation, the Board also considers another factor: Is the extra safety worth the cost of the modification or payload cut?

► **UAL Coach 2% Safer**—One CAB official has unofficially computed the increased passenger risk of most airlines' DC-4 seating density by comparison with United's new standard. Here is how he does it (and he warns that this is a hasty calculation because of the suddenness of United's change):

The airline passenger's odds against a fatal accident on a 1,000-mi. flight (typical coach distance) average better than 100,000 to one. Assume that 25% of the crashes are the type in which exit availability and aisle crowding are factors (for United, which operates no coaches over water, this means fire after a landing or takeoff accident). Then, assume an optimistic 15% of the flights running a full load, or nearly so. Applying the 15% to the 25%, you now have only about 4% of the total fatal-type crashes theoretically affected by greater crowding than United's Patterson will allow.

Finally, this statistician gives United coaches a three-to-two safety advantage in those 4% of the fatal-type crashes (figuring that United's new DC-4 man-per-exit ratio is 11, compared with average ratio of 14; then broadening the spread to 15 to 10 on the strength of Patterson's warning against congestion in narrow aisles necessitated by five-abreast seating).

Putting that all together, you come up with perhaps a 2% extra safety factor on the United DC-4 coach, compared with the average of other DC-4 coach operators.

However, United's main competitors, American and TWA, use DC-6 and Constellation coaches, which are not only safer than DC-4s, especially when it comes to takeoff and landing, but also provide about the same exit availability as United's new DC-4 coach standard, the CAB official points out. That points up one reason why CAB allowed a lower exit ratio on the DC-4—because it is obsolescent.

► **United Price Higher**—Going on from the seating-safety statistic, the CAB official takes up price importance in assessing the practicality of any safety improvement.

The increased seating density on most DC-4 coaches allows airlines to make standard profits at a one-fourth to one-third reduction in fare (50% more passengers, 33% lower fare per passenger). When the passenger weighs

the advantage of so great a price cut, he may consider the crowding is worth it. Civil Aeronautics Board figured that it is worth the small risk.

Finally, the CAB official points out that if the potential coach customer could not get that fare reduction to fly on his vacation he might not fly at all; and in that case he probably would drive his auto to some place nearer.

Since CAB required that DC-4 day coaches have seating capacity of 64 or more, Patterson's cutting his coach seating to 54 invalidates his coach tariff. By cutting his coach seating density, Patterson is forcing the Board to suspend his coach tariff. United may have to file a higher coach fare than competitors everywhere, the CAB Rates division believes.

Patterson, Horne Aircoach Telegrams

Following are texts of the telegram exchange between President W. A. Patterson of United Air Lines and CAA Administrator Charles Horne on the aircoach seating controversy:

To Charles F. Horne,
Administrator of Civil Aeronautics:

We have just examined the results of our tests on the evacuation of high-density aircraft. The tests proved to me that the present civil air regulation which has been our guide up to now is inadequate to give reasonable safety in case of fire or ditching.

For your information, we have, as of this date, reduced the DC-4 coach capacity to 54 passengers, which eliminates three-abreast seating. Center seats will remain in the airplane until such time as they can be removed. In the interim, passengers will not be allowed to sit three abreast during landings and takeoffs.

We have made this policy decision without publicity. However, you must appreciate that if an inquiry is made by the press, a statement must be made. If this inquiry does come, our statement will be as follows:

"Our research indicates that, in the event of a takeoff or landing accident, high-density loading might cause undue congestion and thereby create a safety hazard. We have had a perfect safety record in our air tourist operations, and we wish to avoid anything which might constitute an avoidable hazard to our passengers. Further studies on the subject of high-density loading are being conducted."

We hesitate to make this decision because of our concern that it may arouse public debate with carriers who may disagree with our findings, or that it may arouse public criticism of your administration. We concluded that honesty to the public was our first responsibility.

We could not with a clear conscience, in view of our findings, avoid immediate action. This has been done as quietly as possible in the hope that this controversy will not occur. We will leave to your judgment if other carriers should be advised of our action. What other airlines do will have no influence on this decision. If you have any ideas on how we can maintain our objective to keep this action on a constructive level, please wire or phone your suggestion.

W. A. Patterson, President,
United Air Lines

To W. A. Patterson, President,
United Air Lines, Inc.

Your decision to reduce maximum number of passengers on your DC-4 coaches shows a commendable desire to provide a higher degree of evacuation safety than that required by existing regulations.

As you are aware, our researchers have cooperated with your Cornell tests, which supplement and confirm other tests and studies previously made jointly by CAA, CAB and ATA. Careful studies of Cornell report do not appear to provide sufficient new knowledge to warrant changed recommendations to CAB for new regulations. The basic factor in both Cornell and previous studies appears to be that improved crew training is most valuable in insuring rapid evacuation, and that seat configuration is not as important.

I will appreciate any further information you may have and request that your experts meet with CAA people in Washington as soon as practicable to explain basis on which your analysis of Cornell data caused arrival at decisions you have taken.

I urge that you make your decisions and your test data available to all aircraft operators concerned at once, or authorize me to do so in accordance with standard CAA policy.

Charles F. Horne

THROUGH THE CANOPY

A dummy, strapped in an ejection seat, shoots upward after being fired through the closed plexiglas canopy of a fighter plane mockup during Navy tests. Note shattered pieces of white-painted canopy in the air. Since canopies sometimes jam shut, Navy is running tests to determine feasibility of humans ejecting through them in emergencies.

CAA Reshuffles Its Development Setup

Washington observers last week saw the abolition of Civil Aeronautics Administration's Office of Aviation Development (OAD) and the redistribution of its functions as a stepup in power personally for Joseph D. Blatt, recently named assistant administrator for program coordination. Otherwise, it appeared to be more of a paper reshuffling within the agency than anything else.

Under the new plan, the two former top men in OAD now report to Blatt, who has general supervision over development and fostering of agricultural, industrial, executive, corporate and personal flying and aviation education.

Wiley Wright, former director of Aviation Development, has been named director of General Aviation Staff; Howard Sinclair, former chief of Aviation Education Section in OAD, becomes director of Aviation Education Staff.

▶ **Other Functions Move**—Three other functions of OAD go back where they came from at the time the newest CAA office was established in 1948-1949 under former CAA Administrator D. W. Reutzel.

Flight information activities such as Airman's Guide, etc., go back to the Office of Aviation Information. Air Marking, still headed by Blanche Noyes, goes back to Office of Federal Airways, and Link Training goes to Office of Aviation Safety (OAS). Technical engineering advice on development problems is expected to be supplied to Blatt by the technical staff of OAS.

At the time of the Reutzel reorganization, one reorganization ago as they date them in CAA, a modest $150,000 congressional appropriation for cross-wind landing gear development had been pretty well spent, but efforts to expand CAA technical development on personal planes had received chilly treatment from the aircraft manufacturers. The attitude continued in spite of CAA's offers of contracts to an industry which already had begun to suffer in the collapse of the postwar private plane boom.

▶ **Leaders Left**—About the time OAD was established, most of the constructive leaders in CAA aviation developments for personal and business flying who had gathered under Dr. T. P. Wright had left the agency. These included such men as John H. Geisse, primarily responsible for the cross-wind

gear program; W. L. Jack Nelson, first secretary of the Personal Flying Development Advisory Committee; his successor, H. Lloyd Child, and Dr. Dean Brimhall, whose research had been an important factor in relaxing medical requirements for private pilot licenses.

Main credit to OAD during its short lifespan goes for its part in development of the CAA-sponsored AG-1 agricultural experimental plane designed by Prof. Fred E. Weick at Texas A&M College with industry cooperation; it was later built and flight-demonstrated to agricultural operators across the country.

Features of the plane and its spraying and dusting systems are expected to appear in some forthcoming commercially produced agricultural planes, but there has been no announcement of a plan to build a plane essentially similar to the AG-1 itself.

Prop Wash Causes Lightplane Crashes

(McGraw-Hill World News)

London—The Ministry of Civil Aviation claims that in the past few months it has had "numerous cases" of light airplanes losing control after running into turbulence created by the propeller wash of large civil transports.

A case in point, MCA's accident investigating team says, occurred at London Airport Aug. 1. A D-H Rapide biplane, operating pleasure flights for a London firm, was cleared to land behind a Stratocruiser. Approaching at 300 ft. and 100 mph. and starting a turn, the Rapide ran into severe turbulence and went out of control.

"In a rapid movement," the report says, "the aircraft was lifted to the right on an even keel and violently rocked several times. The pilot immediately increased engine power to regain control, but the aircraft was now thrown violently to the left, still on an even keel. It then started to lose height rapidly."

In the resulting crash, five of nine passengers were injured.

Referring to other similar crashes investigated subsequently, the report says, "Small aircraft have encountered turbulence of such a nature at distances exceeding one mile from other aircraft. It appears that in conditions of little or no wind the turbulence is likely to persist near the ground for an appreciable length of time."

All-Women Air Race

The All-Women Transcontinental Air Race will be held July 3-8 next year, starting at Lawrence, Mass., terminating at Long Beach, Calif.

Navy Confirms Aircraft Cutbacks

F9F-6, AD-5 and FJ-2 programs trimmed heavily under Defense prodding to phase out obsolescing types.

Navy last week confirmed AVIATION WEEK's exclusive story of Nov. 24 announcing production cutbacks in Navy contracts with Grumman Aircraft Engineering Corp., Douglas Aircraft Co., Inc. and North American Aviation, Inc. Navy also confirmed that the cutbacks were made as a result of prodding by Defense Secretary Robert Lovett to phase out production of all rapidly obsolescing military aircraft before the end of 1954.

Earlier, USAF had confirmed that its Lockheed Starfire (F-94C) and Northrop Scorpion (F-89) production programs also had been cut back as reported in AVIATION WEEK (Nov. 24, p. 14 and Dec. 1, p. 7).

The Navy-announced cutbacks are:

• **Grumman.** Production of the swept-wing Cougar (F9F-6) is reduced by 18%. Since well over a thousand Cougars had been programmed, this represents a heavy slash in Grumman's production plans. Only the F9F-6 program has been cut. This version is powered by an advanced version of the Pratt & Whitney J48 centrifugal-flow turbojet. A relatively small quantity of F9F-7s powered by an advanced version of the Allison J33 turbojet will be retained in the production program.

• **Douglas.** Production of the Skyraider AD-5 is reduced by 13%. This venerable combat veteran of the Korean war has set a new standard of military performance for piston-powered aircraft both in carrying a 6,400-lb. bomb load (more than the World War II load of a B-17) regularly off carrier decks and in durability under enemy fire. Special version of the Skyraider equipped with radar and weather-recording gear will continue in fleet service long after the attack versions have been replaced by more modern turbine-powered aircraft.

• **North American.** Production of the Fury (FJ-2) has been reduced by 33%. AVIATION WEEK inadvertently reported earlier that the North American cut would come in Savage (AJ-1) production. The FJ-2 is the Navy's version of the USAF Sabre (F-86). First production version of the Fury is scheduled to be delivered from North American's Columbus, Ohio, plant in mid-December.

► **Defense Request**—The cutbacks concern aircraft largely scheduled to be delivered during the last half of 1954 although a few earlier deliveries are affected. All production work now in progress will be continued on these three types. Navy emphasized that the

UNDERNEATH THE STARFIRE

Lockheed F-94C Starfire rolls over on its port wing, providing a detailed plan-view of its underside. Note the swept horizontal tail, fitted with leading edge deicer boots. The two-seat all-weather USAF interceptor features all-rocket armament which can be electronically aimed and fired without the crew seeing the target. Powerplant is a P&WA J48 with afterburner providing about 9,000 lb. thrust.

cutbacks had been implemented because of a Defense Department request to cut back contracts for production of aircraft that were facing a relatively short life as first-line aircraft and that emphasis would be placed on bringing more modern types into production sooner.

Observers noted reluctance of the Navy to make the cuts since it will now actually obtain fewer modern aircraft types than those originally scheduled because of the increased cost of the newer types. These cutbacks will also delay the fleet aircraft modernization program because the newer types will be available later and in smaller quantities.

Weight Limits Upped For Army Aircraft

Weight limitations on Army helicopters have been lifted and the allowable empty weight of fixed-wing aircraft doubled, according to a new agreement between the Army and the Air Force.

The new agreement puts a limit of 5,000 lb. empty weight on Army fixed-wing aircraft. It specifies that the weight limitation provisions will be reviewed on request of the Secretary of the Army or Secretary of the Air Force to keep the limitation "realistic."

Previous limitations were imposed by a joint Army-Air Force conference that restricted fixed-wing aircraft for the Army to 2,500 lb. and helicopters to 4,000 lb. These limitations have been a matter of criticism by many Army aviation adherents. The new arrangement is considered a long step forward by Army aviators.

Ideal solution, they say, would be to make the limitation entirely one of function, without any specific weight provisions. There is hope that this may be achieved later as the next step in the rapid growth of Army aviation.

This latest in the series of compromises between Army and Air Force—over the roles and types of aircraft that each will use—defines these Army air functions as a basis for procurement requirements:

- **Observation** to locate, verify and evaluate targets, including limited aerial photography.
- **Control** of Army forces.
- **Command**, courier and liaison missions in combat zone and training.
- **Aerial wire laying** in the combat zone.
- **Transporting** supplies, equipment, personnel and small units in the combat zone.
- **Aeromedical evacuation** in the combat zone.
- **Artillery** and topographical survey.

Air Force will continue to provide these air functions for Army:

- **Airlift of supplies,** equipment, personnel and units, from outside to within the combat zone.
- **Airlift to evacuate** personnel and materiel from the combat zone.
- **Airlift for troops,** supplies and equipment in assault and subsequent airborne operations.
- **Aeromedical evacuations** from the initial point of treatment or hospitalization to points outside the combat zone, and temporary evacuation of all casualties in airborne operations, until ground linkup is attained.

Faster Delivery

- **New inspection of engines cuts costs and time.**
- **Method proves successful at P&W and GE plants.**

Navy and Air Force are getting faster delivery of aircraft engines at lower cost as a result of a new method of inspection and acceptance testing.

Already adjudged successful at Pratt & Whitney Aircraft's East Hartford plant and General Electric's West Lynn plant, the services are planning its early extension to Allison at Indianapolis and Westinghouse at Kansas City.

▶ **Procedure**—Briefly here is how the plan works (full details in AVIATION WEEK Aug. 4, p. 213):

An initial batch of 125 engines is run through normal acceptance procedures with a green test run, tear-down and inspection after the green run, re-assembled and given a final test run. If no more than one major defect, sufficient to cause engine failure or malfunctioning, is found in the initial batch of 125 engines the green run, tear-down, inspection and re-assembly are eliminated for one out of every two engines until 75 more engines have been torn down and inspected.

If no more than one major defect is found in this batch the rate is increased to one out of four engines until an additional 75 engines have been inspected. If this produces no more than a single major defect the inspection procedure continues at a rate of one in 10.

Whenever a second defect is found in any given batch of engines before 75 engines have been torn down, the inspection rate is reduced to the next lower level.

In the Navy system, this reduction is optional at the discretion of the resident plant inspector and depending on the type of defect discovered. In the Air Force plan the reduction is mandatory. Total of 525 engines must have passed the statistical sampling method before the 1-out-of-10 inspection rate can be applied.

▶ **Results**—Here is what the plan has accomplished so far:

- **Saves money.** Navy figures show that P&WA has saved an average of $650 per engine on oil, fuel and labor alone under the new plan. Additional savings result from elimination of replacement parts damaged during the tear-down and inspection. At GE, the Air Force says present savings average $450 per engine with an expected increase to $500 soon.
- **Speeds deliveries.** Time saved by elimination of the green test run (averaging about three hours) plus tear-down, inspection and re-assembly increases the delivery capacity of any specific plant substantially. In addition, less labor is required to handle an accelerated delivery schedule.
- **Conserves test facilities.** Engine test cells, particularly for jets, have been a bottleneck ever since the post-Korean production expansion began. Elimination of the green run cuts test cell time

NEW ITALIAN ADVANCED TRAINER

Two-place Macchi M.B. 323 advanced trainer has been designed for a competition sponsored by the Italian air force. It will compete with the Piaggio P.150 and Fiat G.49 for a production contract. The M.B. 323 is powered by a P&WA R1340 of 610 takeoff hp. and has a top speed of approximately 230 mph. Its flight duration is 3.2 hr. Construction is all metal. The large single-piece canopy provides good visibility. Tricycle landing gear also can be fitted on the craft.

required for nine out of ten engines in half.

The statistical sampling program was originally applied by the Navy at P&WA in 1950 as an emergency measure to speed deliveries on the J42 turbojet by easing a production test cell bottleneck. It worked out well until the end of J42 production and was extended to cover the R4360 and R2800 piston engines in the summer of 1951.

The J48 was included in the plan in June of 1952 and after it had passed through a period of component redesign this engine reached the 1-in-10 inspection level in October.

The Air Force began using the plan at General Electric's West Lynn plant on the J47-25 and J47-27 last May and reached a rate of one in 10 in September.

The Navy also tried the plan for six months with the Westinghouse J34 turbojet in the Kansas City plant but abandoned it because of production problems there.

Short Bros. Cites Need for Jet Orders

(McGraw-Hill World News)

London—The first English Electric Canberra jet bomber to be built by Short Bros. & Harland of Belfast has made its maiden flight. Short's chairman, Rear Adm. M. S. Slattery, took the opportunity to make a complaint: Unlike most British aircraft manufacturers, he had labor, machines, and production capacity; but he needed more orders badly.

Short Bros. is also subcontracting production of the Series 2 Comet, but Adm. Slattery said he only has orders for 15 so far.

The first of these would be ready by the summer of 1954 and by the end of 1955 his plant would be in a position to turn out one a week if the orders were forthcoming.

So far only about 32 Series 2 Comets have been ordered, and last week de Havilland announced that a new Comet production line was being planned at Broughton, near Cheshire—de Havilland's biggest production unit, now making Venoms, Herons, Doves and Comet parts.

De Havilland is confident further orders for Comet 2s will be forthcoming and large orders for Comet 3s. Production of the last of 21 Series 1 Comets is almost in sight at the de Havilland production line in Hatfield, Herts.

With orders, Adm. Slattery thinks, "We can produce the aircraft as well and as quickly as the U. S. can, and at much less cost." Short Bros. is one of three companies subcontracting production of the Canberra. A. V. Roe and Handley Page have yet to announce their first production model. Slattery's remarks indicate that the Canberra orders in the three subcontracting plants are small, perhaps in the neighborhood of 100 each.

Short Bros., according to Slattery, is one of the few British aircraft plants where labor is willing and able to work day and night shifts. He figured most British aircraft factories worked only 8 or 10 hours a day.

Short also builds the S.A.4 four-jet research bomber, the second model of which flew for the first time last summer.

World Aircoach

- **IATA conference plans global service by 1954.**
- **Europe-wide network to commence next April.**

Worldwide aircoach service is expected to become a reality by Apr. 1, 1954, as a result of agreements reached by member airlines of the International Air Transport Assn. (IATA) at recent conferences in Cannes, France.

Approval of a network of air tourist services throughout Europe, expected to go into operation next Apr. 1, will be the first big preliminary step toward globe-girdling aircoach.

Dennis, H. Handover, conference chairman, forecast "almost an economic revolution in air transport" and added that by the time the new services have become fully operative "the major portion of international air passenger traffic will be carried on tourist, rather than first-class flights and the economic basis of the industry will be mass rather than deluxe transport."

▶ **Calendar**—The 67 member airlines from about 50 countries which comprise the IATA Traffic Conferences decide policy on questions of international fares, rates and other tariff matters in unanimous decisions which are subject to approval of their respective governments.

The calendar of aircoach extension decided on by the conferences:

- **Apr. 1, 1953.** Tourist services between Europe and the Middle East—Amman, Beirut, Cairo, Damascus, Haifa, Jerusalem, Tel Aviv and Cyprus.
- **Oct. 1, 1953.** The network will extend from the Middle East to India, Pakistan and Ceylon, and from Europe and the Middle East to South Africa.
- **Apr. 1, 1954.** Aircoach will reach Hong Kong, Manila, Tovko, Australasia and across the Pacific to South America, San Francisco and Vancouver to link up with Western Hemisphere networks and trans-Atlantic routes.

It is expected that when this program becomes a reality, about half of the international passenger fleet of 2,500 planes will be converted to high-density aircoach seating.

Fares will vary from route to route but it is expected that coach rates will be about 20 to 25% less than first-class fares. Present aircoach and first-class fares in the Western Hemisphere and over the Atlantic are expected to remain about the same. A third class, called "Class B," is expected to be about 10% below tourist rates and is planned for the Far East, the Middle East and the West Africa routes.

There will be no appreciable change in cargo rates throughout the period of this agreement, but plans to increase cargo tonnage across the Atlantic will be discussed at a special meeting of IATA in February. The next traffic conferences will be held in November 1953.

New South Africa Services Sought

(McGraw-Hill World News)

Johannesburg—A number of new operators are seeking to crack the passenger and freight market held by British Overseas Airways Corp. and South African Airways on the Rhodesian-Britain run.

License applications have been made to the General African Air Authority by several independent carriers who claim they will cut present fares by 40%.

First new operator to get a license is Hunting Air Transport Co., London, now operating to Nairobi. Airwork Ltd. has applied for a London-Salisbury route using Vickers Viking and Handley Page Hermes transports. Skyways Ltd. is seeking an aircoach run by way of Mombasa, Nairobi, Khartoum, Wadi, Haifa, Cyprus and Malta to London. Tropic Airways is applying for a service from Livingstone using Avro Yorks and from Salisbury with Douglas Dakotas.

Jets for Cotton?

(McGraw-Hill World News)

Rio de Janeiro—A deal whereby Brazil would barter $14 million worth of cotton in return for 70 Gloster Meteor jet planes apparently has run into snags. Indications are that the Bank of Brazil does not have sufficient stocks of the particular grade of cotton the British want and there also is some disagreement as to how much it's worth.

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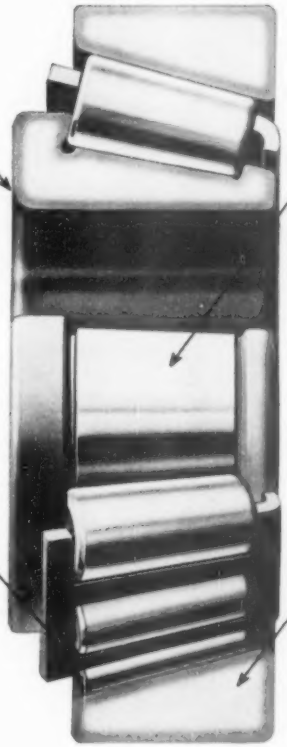
5 **CASE-HARDENED BEARING SURFACES**—to resist wear.



6 **MICRO-INCH SURFACE FINISH**—to minimize friction.

7 **CHOICE OF 5850 SIZES.**

8 **TIMKEN FINE ALLOY STEEL**—specially developed to give long bearing life.

9 **TOUGH CORE**—to resist shock.

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TAPERED ROLLER BEARINGS

NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL AND THRUST ◫ LOADS OR ANY COMBINATION

FLAREOUT landing of production HTK-1 during flight tests shows off Kaman Navy copter's neat profile. This craft evolved out of the Kaman Aircraft Corp. K-225 civilian helicopter.

NAVY SERVICE awaits these production HTK-1s after flight tests at Kaman's Windsor Locks plant. One copter is undergoing suitability tests by Army Ground Forces at Ft. Bragg.

Kaman HTK-1 Copters Roll Out for Navy

Kaman's 2-3-place HTK-1, probably the world's only intermeshing-type helicopter in full production, is moving through the firm's Windsor Locks, Conn., plant on an assembly-line basis. Deliveries are being made to the Navy and Marines, and one of the copters is undergoing suitability tests by the Army Ground Forces at Ft. Bragg, N. C.

Basically a training craft, the HTK-1 can easily be adapted to medical evacuation duties—the left half of the canopy swings outward to facilitate loading of litters.

The HTK started out as a military version of the Kaman K-225 civilian copter, but finally evolved into an entirely new design, in which the intermeshing rotors and Kaman servo-tab control system were retained.

► **Design Changes**—Several major modifications set the production HTK-1 apart from the prototype HTK which made its debut at the Helicopter Forum in April 1951.

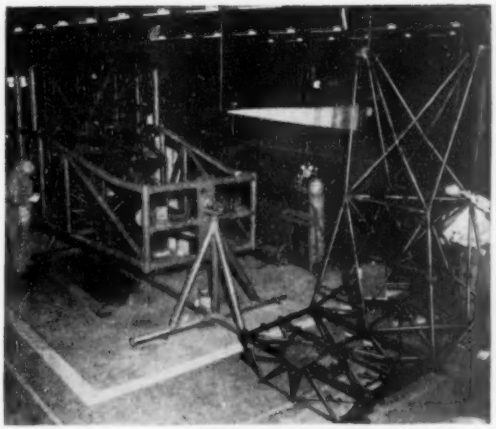
Changes include shortened tailboom, added fin area, and aerodynamic changes in the rotor blades. Shortening the tailboom caused a loss of tail moment arm; so the area of the outboard fins was increased from 10½ sq. ft. to 12½ sq. ft., and ventral and dorsal fins, each of 8½ sq. ft., were added on the tailboom.

The prototype HTK made its original appearance with a pair of K-225 rotor blades, which have equal chord throughout. But the production HTK-1 has newly designed blades that are narrower than the old blades, widening at the servo-tab, and tapering toward the tip.

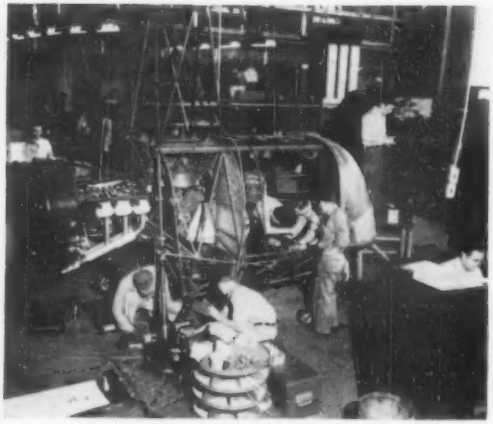
The flexible blades are actuated by the servo-tabs, a distinctive Kaman feature.

The HTK-1 recently received CAA approved-type certificate 1H3 (Navy, in its contract award to Kaman, specified a craft so designed and constructed as to be certificated). Commercial designation of the new helicopter will be K-240.

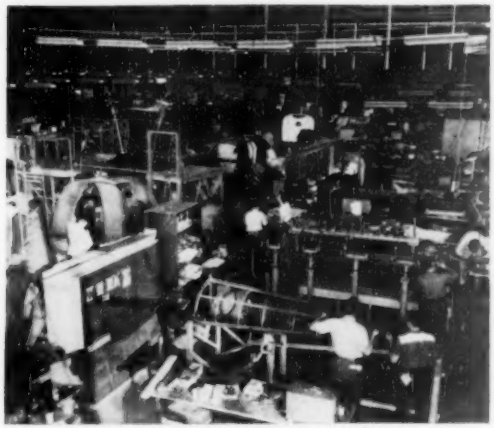
At present, Kaman has slightly over



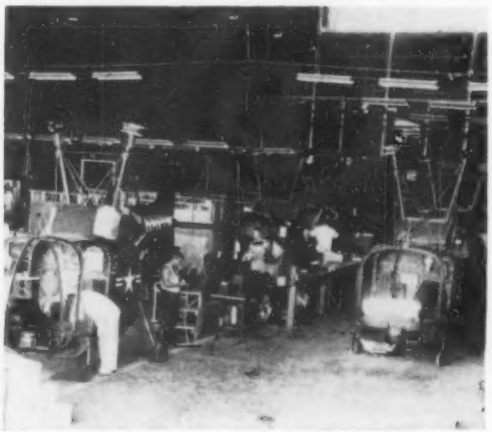
1 HTK-1 fuselage starts with small subassemblies which are put in the main jig (left), and welded to form main frame (right).



2 Engine, transmission, controls, and electrical and instrument lines are installed. Shock struts of landing gear are inflated.

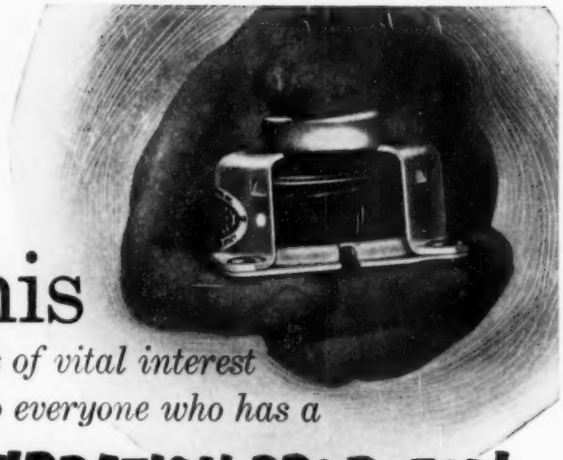


3 The tailboom is made here. The boom is all-metal, as is the horizontal stabilizer and part of the ventral and dorsal fins.



4 Cockpit furnishings and the tailboom, with its surfaces attached, are added. The engine is then check-run for an hour.

5 Blade installation moves outdoors on calm days. After flight test, craft gets Navy paint job. To get copter inside paint shop, rotors must be removed. They are marked, for return to same hub they were attached to during flight test.



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is of vital interest to everyone who has a

VIBRATION PROBLEM!

Here is a fresh approach to vibration and shock control – an *all-metal* mount! Just look at the careful fabrication of the stainless steel wire cushioning. This is the heart of the new Robinson Met-L-Flex mount. Shock and vibration are absorbed *from every angle*, thereby isolating and protecting the mounted equipment.

Wide Range of Applications

Robinson Met-L-Flex design control can be applied to the mountings for delicate precision equipment or heavy machinery.

Far better vibration control has been sorely needed to keep pace with modern advances in the design and use of electronic and precision equipment. Well, here it is!

Great Cost Savings

Where the new principle of all-metal vibration control is used with Robinson unit mounts or engineered mounting systems it effects decided economy. It not only permits simplified design and construction of equipment, but also contributes to far longer useful life.

Outstanding Performance

Robinson Met-L-Flex mounts were originally developed to meet unprecedented, severe conditions of modern high speed planes.

From take-off to landing a plane's vital equipment is subject to the combined violence of shock and vibration. Sure protection is needed. Met-L-Flex meets such challenges with flying colors, to the great relief of engineers. Moreover, unlike old-fashioned rubber mountings, Robinson Met-L-Flex mounts perform at peak efficiency under any atmospheric conditions. They are not daunted by oil, temperature extremes, or moisture – and the need for replacement due to fatigue is virtually nil.

Proved and Accepted

Robinson mounts have been tested and accepted by more than three hundred electronics, aircraft and industrial manufacturers. With such a background and record of performance, Robinson offers the advice and counsel of its engineers toward finding the best and most economical answer for every problem of vibration and shock.

JUST WRITE AND ASK US

If you are an engineer, architect or manufacturer who would be interested in having more information as to how this new kind of engineered vibration control might help your special problem, we will be glad to hear from you. Drop us a line.

ROBINSON AVIATION INC.
TETERBORO, NEW JERSEY
Vibration Control Engineers

PRODUCTION HTK-1 models have added ventral and dorsal fins. Newly designed rotor blades retain Kaman servo-tab control.

PROTOTYPE HTK started as military version of civilian K-225 copter, but wound up in production as an entirely new design.

900 employes. Production lines are centered in the former National Guard Hangar at Bradley Field. KAC occupies 22 buildings—20 at Bradley and two at nearby Simsbury Airport—with a total area of more than 134,000 sq. ft. A new 104,000-sq. ft. plant, on an 85-acre triangular site at Bloomfield, Conn., should be in full operation by May 1953.

The new plant has been especially designed for helicopter construction, and Kaman expects it will permit a more efficient operation than is possible in the present makeshift arrangement at Bradley. The site is situated between two flight strips—an east-west one of 4,100 ft., and a north-south strip of 2,700 ft.

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Many of the built-in features are the result of successful use in other Westinghouse panel designs . . . your guarantee of performance-proved equipment.

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AVIATION EQUIPMENT

CAPRONI'S LATEST is this little F.5 jet trainer, built of wood and powered by a Turbomeca Palas engine. This aspect of the plane emphasizes the large areas of Perspex at the cockpit, and shows off the jet installation

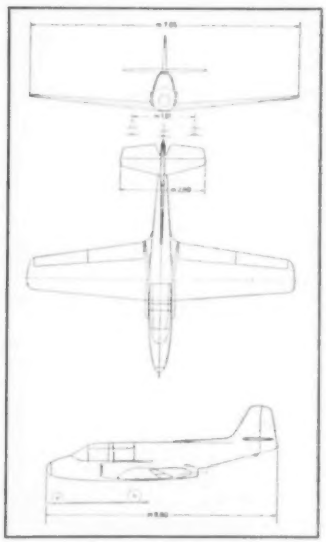
Italian Jet Plane Aims at Economy

Latest in lightweight jet trainers is the F.5, a plywood, low-wing monoplane developed by the Italian firm of Aero Caproni Trento.

ACT designed and built the two-place tandem trainer for service and reserve pilot schooling, aiming at a plane that would be economical to build and operate. That general consideration led to use of a conventional airplane geometry, a proven Turbomeca Palas turbojet engine and all-wood construction.

►**Structural Details**—The wing is built around a one-piece box spar with laminated Douglas fir walls and birch plywood webs. Covering is plywood.

The forward support for the landing gear leg is an auxiliary wing spar; this member also serves to unload wing torsion into the fuselage.



Caproni F-5 Trainer

Flaps and ailerons are carried on a rear longeron. Flaps are operated hydraulically by hand pump.

The fuselage is divided into two sections: Forward, containing cockpits, operating gear and nosewheel, is integral with the wing; rear, with jet unit attachments and tail assembly. Bolts fasten these sections together.

Fuselage is built up of simple and box frames, covered with birch plywood.

Tail surfaces are similar to the wings in construction details. Fin and stabilizer form part of the fuselage and are covered with birch plywood. Rudder and elevators are fabric covered.

►**Landing Gear**—Main landing gear leg of the tricycle undercarriage is hinged to the auxiliary wing spar and retracts into the wing. Nose wheel leg uses a long-stroke shock absorber; it retracts back into the fuselage. Part of the nosewheel remains outside the fuselage contour, so that in a wheels-up landing the fuselage and jet unit are protected. Retraction of the gear is mechanical.

An air brake, operated with a hydraulic strut, is fitted to the fuselage belly. It increases the overall drag without much change in pitching moment.

Noteworthy feature of the cockpit design is the large amount of Perspex canopy area provided. Visibility should be excellent from either seat. The coverings can be ejected in flight, in the event of trouble.

The forward position is for the student, and contains all the necessary instruments for flight and operation of the aircraft. The rear position, for the instructor, has only three instruments; the instructor must peer over the student's shoulders to see the rest of the instruments.

►**Installations**—There are two fuel tanks, one of gasoline for engine starting and one for kerosene. The gasoline tank is located outside the fuselage and holds

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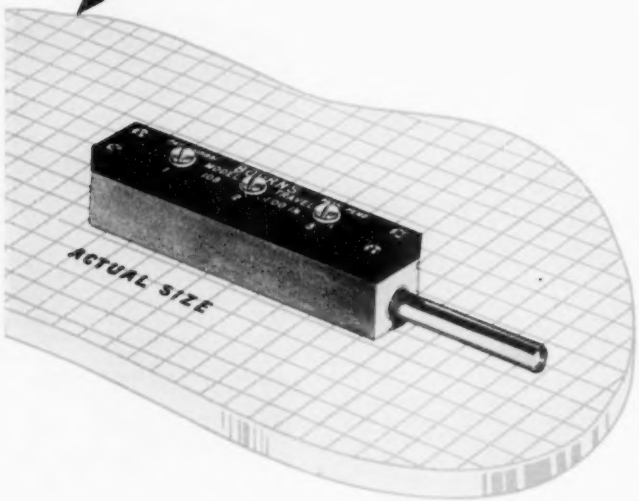

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Technical publication describing standard models and special applications available upon request.

BOURNS designs and manufactures other potentiometer instruments which measure such physical variables as gage pressure, differential pressure, altitude and acceleration.

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only 1.3 gal.; the kerosene tank holds 38.8 gal. and is located on the airplane CG, just behind the second seat.

It is possible to increase the fuel capacity by using nylon-rubber tanks internally in the wings, or with auxiliary wingtip tanks. An alternate tank can be installed in place of the instructor for long navigational training flights.

Fuel and lubrication systems are designed for inverted flight.

The electrical system is 24-v., battery-supplied. An outside trolley is supplied for starting the jet engine.

Radio is a VHF transmitter-receiver.

Fire extinguishing system is carbon dioxide, operated by the first pilot.

The Turbomeca Palas has a static thrust of 330 lb. It is located behind the wing in the rear fuselage belly. Jet exhaust is directed straight out; firewall insulation is done with glass wool.

▶ **Performance**—Maximum speed of the F.5 at sea level is 224 mph., and at altitude, 242 mph. Climb to 16,400 ft. takes 23 min.

Takeoff run with flaps is 920 ft., without flaps is 1,260 ft. Landing run with brakes and flaps is 500 ft., without these aids the run is 795 ft.

Actual ceiling of the craft is 26,300 ft.

Wingspan of the F.5 is 25.8 ft.; overall length, is 21.8 ft. Gross weight is 1,650 lb., and weight empty is 1,032 lb.

With a wing area of 107 sq. ft., the wing loading is about 15 psf. Fuel consumption is about 26 gph.

Scale-Model Tunnel Blows Big Wind

A scale model of the giant propulsion windtunnel being constructed at the Arnold Engineering Development Center, Tullahoma, Tenn., has been placed in operation.

Proposed in December 1951 by Aro, Inc., operating contractors of AEDC, the model transonic tunnel was designed, fabricated and operated on schedule.

Use of the tunnel will be in research on problems associated with the operation of its big brother. It will try out ideas for improvement and modification, and will test installations proposed for the big tunnel.

Power comes from a 3,000-hp. electric motor which drives an air compressor rated at 100,000 cfm. A portion of the air is recirculated through the compressor before it is admitted to the tunnel. This raises the operating temperature so that condensation will not occur in the test section.

Test section is one foot square; test speeds are listed as ". . . over 1,200 mph."

This small-scale tunnel is not a test

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Manufacturing components for the "hot spots" in present-day piston engines requires the best equipment and most modern methods of forming, welding, precision machining and assembly. Ryan's "follow through" service after shipment, and extensive field testing experience, is unmatched in the industry.

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facility for windtunnel models, but a development tool for the big windtunnel. The original three units of the AEDC—engine test, gas dynamics and propulsion windtunnel—are still not complete. The first of these was originally scheduled for shakedown runs in the spring of 1952.

Knit Glass Fabric Used for Radomes

Small production quantities of radomes for guided missiles and aircraft are now being made of woven glass cloth impregnated with resin. In this recently developed process, the glass fiber is woven on shaped knitting machines, similar to those used to make women's full-fashioned hose. The resin is added either by the manufacturer or the purchaser. Molds are not required.

Handling of glass yarn on shaped knitting machines has proved to be a tricky business, so glass-plastic structures until now have usually used the fiber in pressed form.

The knit radomes are made by S. Granoff Mfg. Co., 1481 High St., Central Falls, R. I. Granoff ascribes its success with the knitted process to knowhow gained in the manufacture of industrial fabrics.

DEAN & BENSON RESEARCH, INC.

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AIRCRAFT INDUSTRY

The above engine-cooling fan—built by *THE BENSON MANUFACTURING COMPANY, KANSAS CITY, MISSOURI*—has been engineered by DEAN & BENSON RESEARCH, INC., with fan blades shock-mounted to eliminate transmission of vibration from the engine to the blades. This mounting is patented under U. S. Patent No. 2,436,087.

Designed for low weight, high inertia and high aerodynamic efficiency, these fans not only supply all necessary engine cooling, oil cooling, and carburetor air for submerged power plants, but also act as the flywheel for the engine.

The fan blade shown above is typical of all blades used in DEAN & BENSON RESEARCH, INC., designs. These blades are available in plastic, aluminum or magnesium.

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Inflatable Steel Seal For Giant Air Valves

An inflatable steel seal is the unusual design feature of a family of butterfly valves for airflow control, manufactured by the Henry Pratt Co.

Available in sizes from 36 in. to 168 in. in diameter, and suitable for temperatures ranging to 1,500F, these valves are in use at Air Force, NACA and private contractor facilities which handle huge volumes of heated high-pressure air.

▶ **Pressure-Sealed**—Secret of the Pratt valve is a continuous stressed seal, made of stainless steel or Inconel X, welded to the inside of the valve body. This seal does not touch the valve disk during operation. But when the disk is in the full-closed position, the seal is inflated by fluid pressure, contacts the disc edge and eliminates air leakage past the disk.

On release of the seal pressure, the seal deflates and the valve is ready for operation.

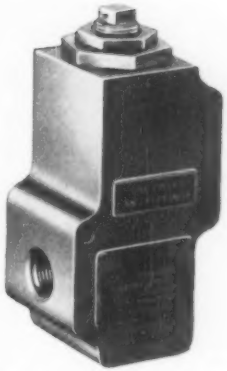
Pratt's development program started in 1948 with an Air Force contract for valves for the Arnold Engineering Development Center at Tullahoma, Tenn. Temperature requirements eliminated the chance of using a rubber-seated valve, and the wide temperature range made it impossible to use a conventional metal seat to get tight shutoff at all temperatures.

Operation of the valves can be by electric, air or hydraulic motor, or by hydraulic or pneumatic cylinder. The valve illustrated (108-in. dia.) uses a Philadelphia Gear Works Limitorque electric motor and worm-gear reducer.

Pressure rating is somewhat a function of valve size. For large diameters and high pressures, the valve disk becomes disproportionately thick and one of the inherent advantages of the butterfly valve—low restriction to flow—is lost.

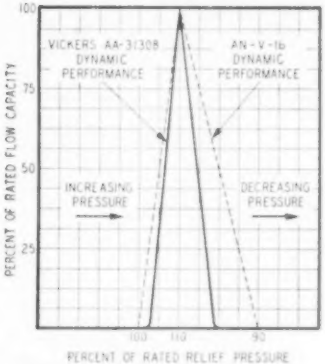
Valves between 36-in. and 60-in. di-

Vickers Model AA-31308-H
AN-6279-8CD

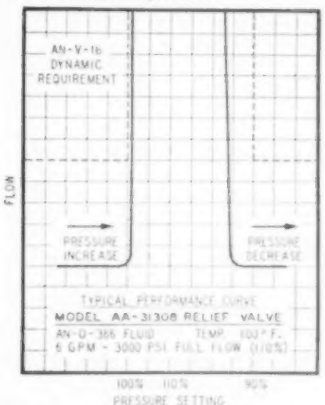


Vickers Model AA-31306-H
AN-6279-6CD

Vickers Model AA-31304-H
AN-6279-4CD



Pressure variation from cracking point to maximum rated capacity of Vickers Two-Port Balanced Piston Relief Valve is considerable less than permissible under Specification MIL-V-5523. Consequently less pressure differential is required between relief valve setting and unloading valve pressure.



Curve showing extremely low internal leakage of Vickers Two-Port Balanced Piston Relief Valve.

These VICKERS RELIEF VALVES

TWO PORT • BALANCED PISTON

Conform to Specification MIL-V-5523

The Vickers Two-Port Balanced Piston Relief Valves illustrated here conform to Specification MIL-V-5523. Their rated capacities (2, 5 and 9 gpm) are greater than required by this Specification (1.5, 3.5 and 6 gpm respectively).

The curves at the left illustrate two important characteristics of these valves: (1) very low pressure variation from cracking point to maximum rated capacity, and (2) extremely low internal leakage (less than required by Specification MIL-V-5523). Smoother operation and greater accuracy throughout a wide range of pressure adjustment are other significant advantages. Operating pressure range is adjustable from 500 to 4500 psi without parts change.

These valves are also available in four-port models and can be provided with a vent control for unloading the system pressure. For further information about the complete line of Vickers Balanced Piston Relief Valves write for new Bulletin A-5204.

VICKERS Incorporated
DIVISION OF THE SPERRY CORPORATION
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ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

(Advertisement)

Valve Talk

for WM. R. WHITTAKER CO., Ltd.

by Marvin Miles,
Senior Member, Aviation Writers Assn.

Stop and consider the problems you would face without the variety of valves, controls and the remote control systems offered by today's $200,000,000-a-year aircraft valve industry.

Foresight and ingenuity have made the valve business a vital component of aircraft production.

Many firms have tried and failed to produce valves, failing primarily because they underestimated the design and production skills necessary. They simply couldn't meet the increasingly high demands of airframe and engine manufacturers — greater performance . . . reduced weight . . . smaller envelope . . .

But certain concerns could answer the demand, at far less trouble and cost than could the majors had they elected to try their hand at producing valves. They have become the established leaders in the valve business.

These are the companies that are so frequently mentioned in my talks with Whittaker people. Together with Whittaker, they have developed valves for every need, perfected production techniques and established service standards that are appreciated by customers both here and abroad.

These outstanding companies not only have the perseverance and ability to create standard lines common to all – they have also delved deeply into specialist fields, varying with each firm, so that between them they meet the widest possible range of demand.

And they meet it with the constant quality improvement and cost reduction that flowers on know-how and specialization.

Inevitably, competition between them is sharp. Whittaker neither underestimates nor undervalues its competitors. Rather, it recognizes their merits and acknowledges their role in advancing the industry.

Take AiResearch – one of the pioneers in the field. Developer of the first hot air valves. Manufacturer of all types of valve equipment for cabin pressurization and temperature control. Highly regarded production-wise and quality-wise. "Tough competition," Whittaker men will tell you.

Or Parker Appliance – another pioneer. Far and away the leader in the development of synthetic rubber seals (O-rings) that have played such a big part in the valve business. Widely known for its fuel selector and check valves, as well as for its single-point underwing refueling system.

Or Weston – specialists in difficult hydraulic problems and the intricacies of hydraulic components. A firm that will step into a particularly tough job, tackle it – and complete it – where no one else can.

Adel Precision – rated as rugged competition by the men at Whittaker. Strong on standard lines of pilot and shut-off valves, also accessories. A big-production firm devoted to perfection of high-demand units, and the reduction of envelope and weight.

General Controls – brings the experience of past industrial techniques to the valve business. Their high production methods have reduced cost on solenoid control valves, compact fuel units and shut-off controls – even down to peanut size.

And Bendix Pacific – among the first to utilize an actuator that can be used for system selection, the well-known Geneva motion to position hydraulic controls. Manufacturers of wide range, from simple on-and-off valves to multi-port products.

And there's Koehler – known for drain cocks, high temperature air and fuel check valves. Specializing in stepped-up production to AN Standards.

Also Hydro-Aire – known for fuel filters, motor-operated 400 cycle valves. For the solution of certain valve problems by cylinder actuation. For the Hytrol unit that permits maximum braking without skidding.

And there are many others . . .

These are the companies that have helped build the aircraft valve business into the solid, recognized industry it is today . . . these firms are on top because their products are tops.

The Whittaker Company respects its competitors.

ameter are 500-lb. pressure valves; up to 168-in. dia., and valves are 300-lb. units.

Manufacturer's address is 2222 S. Halsted St., Chicago 8, Ill.

New De-Icing Setup For 'Ice Wagon'

Ice formation will energize the de-icing equipment soon to be installed on the "Rockcliffe Ice Wagon," Canadian icing research aircraft. Until now, de-icing equipment has been operated by a timing device rather than by actual accretion of ice.

Theory behind the new equipment was developed by Canada's National Aeronautical Establishment; design and engineering were done by Goodyear Tire & Rubber Co.

The new de-icing gear will be installed on wing, fin and stabilizer leading edges of the Ice Wagon, to complement the Goodyear installation already on the propellers and fuselage dorsal fin.

The plane is the fourth to serve in NAE's studies, earlier versions having outlived their usefulness. Its purpose is to fly into areas of icing to measure ice accretion and to compare methods of removal. Research engineers travel on the flights and work out problems as they occur, instead of waiting for the crew to return with data.

The Ice Wagon is a modified Douglas DC-4M, built under license by Canadair, Ltd., Montreal.

Battelle Building German Center

Metallurgical and engineering research to help better Europe's economy will be one of the prime purposes of the new Battelle Memorial Institute for Germany, scheduled to be opened in late spring, 1953.

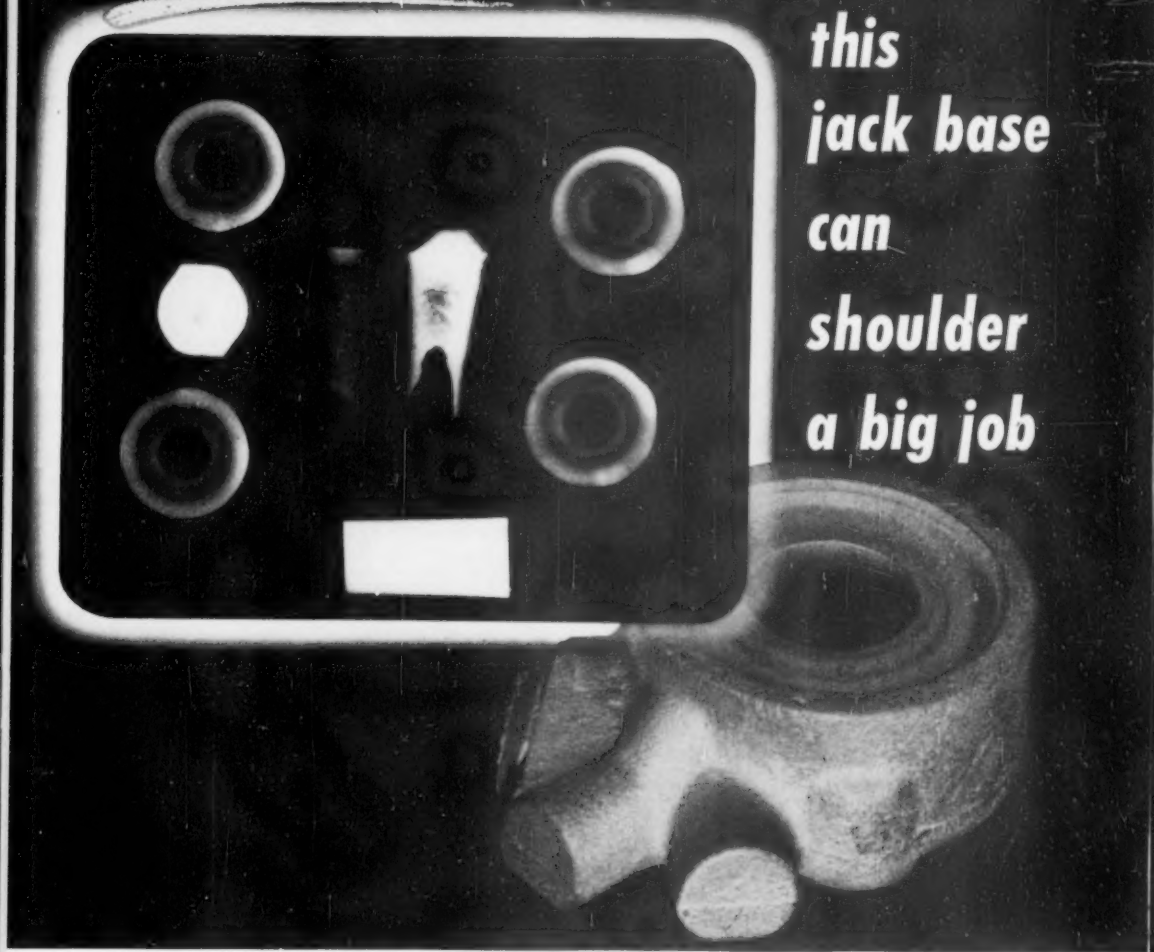
The new facility is being built at Frankfurt am Main on a site presented by that city. One million dollars will be invested in the buildings and an additional half-million will be used for equipment.

Battelle is also establishing a research center at Geneva, Switzerland, and has set up a program of fellowships for selected students in universities of Switzerland and Germany, Director Clyde Williams says.

Initial capital will be provided by Battelle. Operational funds are to be provided by European industries and governments and American industries in Europe. Most of the personnel will be European, with Americans used for administration and liaison. Labs will be staffed with European scientists and technicians.

RADIOGRAPHY MAKES SURE

this jack base can shoulder a big job



Hydraulic jack bases—as cast.

Hydraulic jacks are born to lift loads many times their own weight and size—to stand internal pressures of thousands of pounds per square inch.

This takes sound castings—soundness which only radiography can prove without damage to the part. And the designers, knowing the casting will be sound, can count on strength without excessive weight.

Instances like this show why more and more foundries are making radiography routine. It is the way to be sure only high-quality castings are released.

If you would like to know how radiography can improve your plant operation, talk it over with your x-ray dealer. And, if you wish, we'll send you a free copy of "Radiography As A Foundry Tool."

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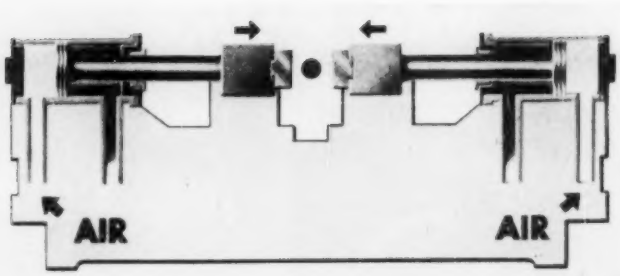
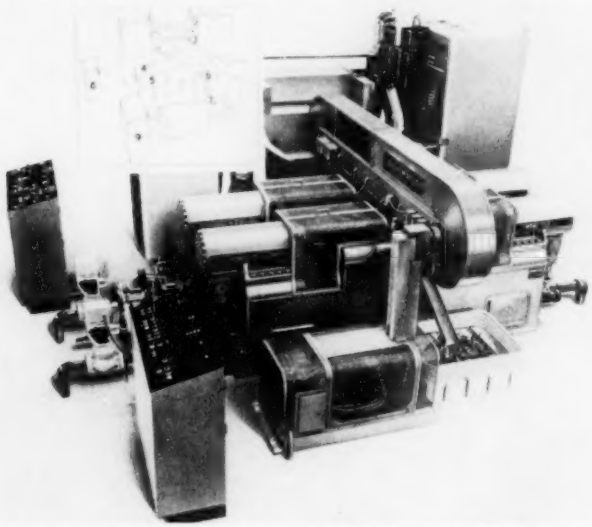


CHAMBERSBURG IMPACTER applies principle of complete absorption of energy when two equal, inelastic masses collide head-on at equal speeds. In the Impacter, this means complete employment of the impellers' energy for deformation of the stock.



AUTOMATIC SET-UP for two Impacter units producing jet blades (figures are keyed to sketch in upper left corner): 1, stock is fed to heating element; 2, heated stock is checked for temperature (under-heated pieces rejected); 3, chute to transfer device for loading conveyor; 4, first Impacter for rough forging; 5, second Impacter for finish forging; 6, forging trimmed from sprue; 7, discharge chute; 8, control for individual Impacters; 9, control for complete process.

Parts Forged by Collision Hammer

By Irving Stone

A new type of hammer tool that forges metal in mid-air by impacting is the approach for forming metals that has been worked out by Chambersburg Engineering Co. Stock is fed through a series of dies that collide against the work, without rebound, to form the part.

The new tool is known as the Cecomatic Impacter and action can be automatic or semi-automatic. Advantages of the technique are reported to include fast processing, longer die life, decreased energy input, improved metal working and lack of vibration.

While the company now stresses the tool's forging potential, other applications, such as extruding, are seen in the continued development of the process.

▶ **Already in Service**—Two of the machines already are in operation, one in aircraft engine work at Thompson Products, Inc., Cleveland. Here the Impacter cold-coins jet engine blades under an Air Force experimental contract. This machine (a No. 6, delivering a 6,000-ft. lb. blow) utilizes a magnetic holder for positioning the blades.

The second machine (also a No. 6) is being used by International Silver Co. for cold-forging stainless steel knife handles at a single blow, with a production rate of 50 per minute.

▶ **Packard Will Use**—Other machines are scheduled to go into operation before the end of the year.

Packard Motor Car Co. will soon get the first of four similar units now being built for automatic precision-forging of blades for General Electric Co.'s J47. Chambersburg says that production rates will be 4 to 6 times that of present methods, depending on size of the work. The Packard machines, embodying two No. 6 Impacters, will be teamed with accessory hoppers, feeds, conveyors, etc. Equipment will include automatic heating facilities (Ohio Crankshaft Co.), temperature controls (Leeds & Northrup Co.) and handling elements (Feedall Co.).

Packard also has ordered an installation employing two 15,000-ft. lb. Impacters as the striking units to forge turbine buckets.

▶ **Other Customers**—Two No. 6 units will go to General Motor Corp.'s Oldsmobile division for impacting rough blades for the J65 Sapphire. The machine is now in its final test stages and will be combined at Oldsmobile with automatic heating and handling equipment built by Induction Heating Corp. of America. Production rates for this machine will be comparable to that of the Packard unit.

Under study for application at Curtiss-Wright Corp.'s Buffalo plant is another Impacter—a No. 4 unit.

A machine with two No. 4 units is scheduled for Utica Drop Forge & Tool Corp. Initially this installation will be fed manually while die development is proved out. An automatic heating cycle, engineered by Chambersburg, is planned for the machine.

▶ **Theory of Action**—Principle of Ceco's new machine is simple. It is based on a law of physics that has been demonstrated in many a classroom—when two inelastic bodies of equal mass travel toward each other at the same speed and collide, both bodies come to rest with a complete absorption of energy.

This principle is mechanically translated in the machine by two opposing members—impellers—moving in a horizontal plane and carrying dies at their extremities. Impeller actuation is by compressed air in opposed cylinders. Stock is positioned in the impact plane, the two dies collide against the material, and the resulting deformation absorbs the impeller energy.

When two operations are required, such as blocking and finishing, two Impacters are installed, one after the

BOTH TYPES, FLARED AND FLARELESS, ARE PRECISION-MADE BY PARKER

Consider your actual *cost* instead of price . . . your rejections of faulty materials. Then you'll discover what other users have learned . . . that Parker is your best bet as the one *reliable* source for top-quality aircraft fittings!

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AN Fitting Catalog 701 and MS Fitting Catalog 4120A1 available from PARKER Aircraft Co. (subsidiary of The PARKER Appliance Company) 5827 West Century Blvd., Los Angeles 45, Calif.

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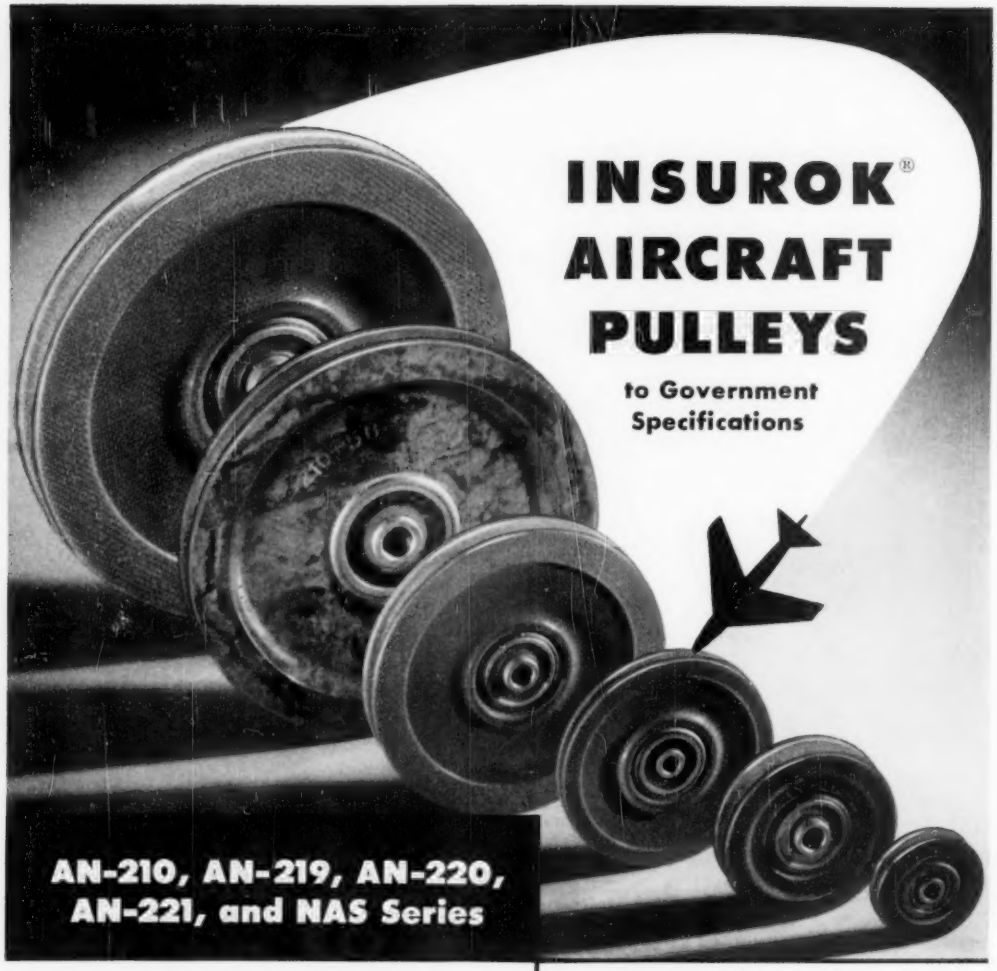
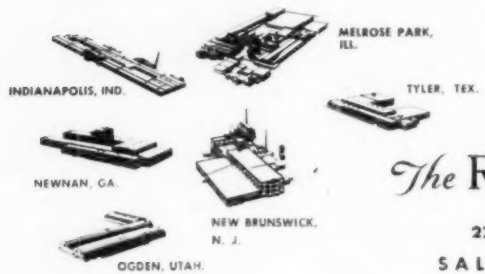


INSUROK® AIRCRAFT PULLEYS

to Government Specifications

AN-210, AN-219, AN-220, AN-221, and NAS Series

Tough, lightweight INSUROK aircraft pulleys are precision made to meet rigid government standards. Richardson's production skill and years of experience give added assurance of top-quality dependability.



LAMINATED OR MACERATED

INSUROK pulleys are made from either laminated or macerated fabric. Both meet government specifications fully, although INSUROK macerated-fabric pulleys cost slightly less.

SELF-EXTINGUISHING

Pulleys are available in fire-retardant materials. Even when ignited by direct flame, they retain no "after-glow" once the flame is withdrawn. This is an important safety feature in checking the spread of fire.

Write for Bulletin

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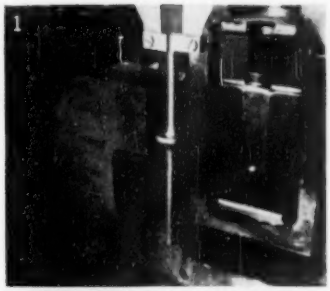
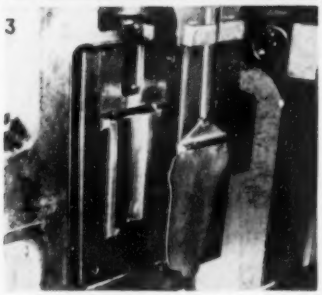




STAINLESS STEEL jet blade is quickly processed in Impacter: 1, induction-heated forging blank is suspended between dies for first blow; 2, blade looks like this after blow, and is ready to move to second Impacter unit; 3, final blow gives blade, ready for trimming.

other for the successive steps. Apparently it would also be feasible to have blocking and finishing impressions in a single set of dies, with the stock being fed for successive blows in the one Impacter, as is now done in the dual installation.

▶ **Advantages**—As a result of the almost complete absorption of energy by the forging and the impellers, there is no shock or vibration—neither in the machine, nor in the floor. Chambersburg says that the Impacter can be located directly in production lines, even if they are on upper floors, and adjacent to sensitive or delicate equipment.

Other advantages advanced for the process are:

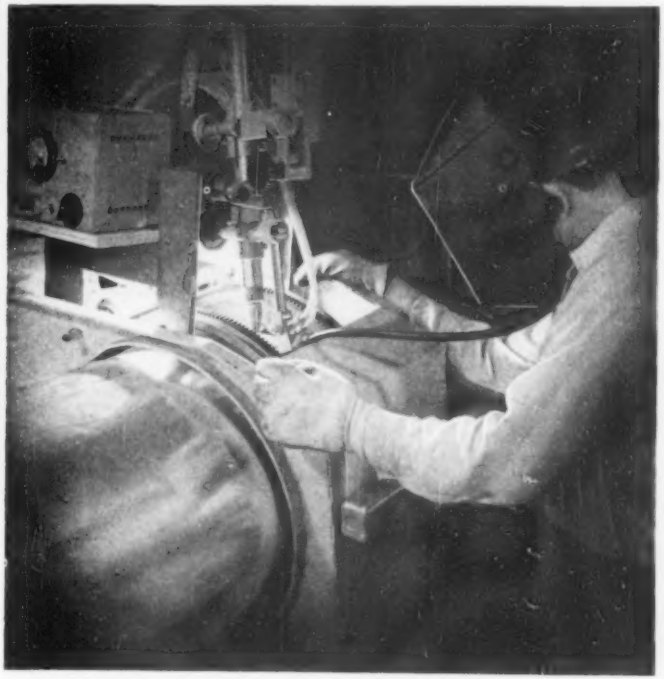
• **Material is worked equally** from both sides instead of from one face. This gives a more uniform working of the metal. In addition, metal travel is less, so that in forging a sphere to a disk, 23% less energy is required than with a conventional hammer.

• **Stock and die** are in contact only when work is being done. This reduction in contact results in lower operating die temperatures, hence longer die life.

• **Stock can be moved faster** because of heat economies involved. There is an appreciable increase in temperature of the stock because energy of the impellers is almost completely absorbed. This leads to ability to process through multiple stations without reheating, and forging with lower initial heat.

▶ **Control Features**—Impeller movement is electronically controlled. Plane of impact is kept on center by an electronic compensator with sensing heads to detect blow eccentricity. Rough adjustment of impeller blow intensity can be made by varying air pressure, while fine adjustment is by varying time of valve openings. Both blow intensity and rate of blows may be pre-set, as may be operations such as die spraying and automatic stock handling.

A blow will not strike if the stock is not properly positioned in the plane of contact, and it is possible to fit



SEWING HOT SEAMS THAT ADD MILES
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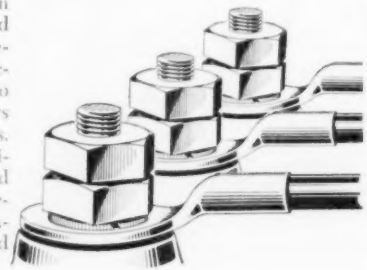
(Advertisement)

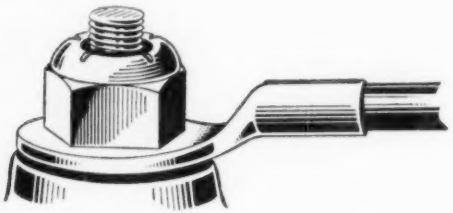
Fastener Problem of the Month

VIBRATION-PROOF ELECTRIC TERMINALS — DECEMBER, 1952

PROBLEM: Severe vibration acting upon standard nuts used on electric terminals too frequently results in loose connections. Double nuts are difficult to adjust correctly and lock washers can tear soft brass connections. Yet the increasing use of electrically powered components and increasing power loads make secure terminal fastenings imperative on modern military and commercial aircraft.



SOLUTION: Positive protection against the loosening effects of vibration is provided by self-locking *brass* Elastic Stop Nuts. The red elastic locking collar provides a constant and positive grip on terminal studs . . . makes continuous performance more certain by preventing ignition or power supply failures. Because Elastic Stop Nuts lock in any position on the stud, whether firmly seated or not, they are easily adjusted. They are readily removed and can be re-used.



YOU may have a similar fastening problem—or a very different one. In any case, you'll find ESNA engineers ready and able to supply a solution. Mail our coupon now, for complete information.

Dept. N10-1225
Elastic Stop Nut Corporation of America
2330 Vauxhall Road, Union, N. J.

Please send me the following free fastening information:

- ☐ Elastic Stop Nut Bulletin
- ☐ Here is a drawing of our product. What fastener do you suggest?
- ☐ AN-ESNA Conversion Chart

Name _____ Title _____

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Street _____

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the machine with a control to reject work which is not at the proper temperature.

It is practicable to enclose the area and introduce an appropriate atmosphere, if desired, since the forging is handled and struck in mid-air.

► **Size Research**—Range of economic power use in the machine is from its rating to about 60% of that value, Chambersburg says. Ratings are by numbers representing maximum energy in thousands of foot pounds per blow. Engineering work on sizes ranging from 4 to 400 in various increments already has been completed.

Research and development on the process is still being conducted to determine full potential. Investigation includes phases of die design, plastic flow and related subjects.

Supplementing Chambersburg's efforts along this line, a research project has been set up at Penn State's Engineering Experiment Station.

PRODUCTION BRIEFING

► **Lindbergh Engineering Co.**, Chicago, maker of heat treat furnaces, has purchased 4½ acres of land in Los Angeles for construction of a plant and offices.

► **Majestic Aircraft Corp.**, Moosup, Conn., has taken over additional space in adjoining buildings and separated assemblies from detail parts production to speed output.

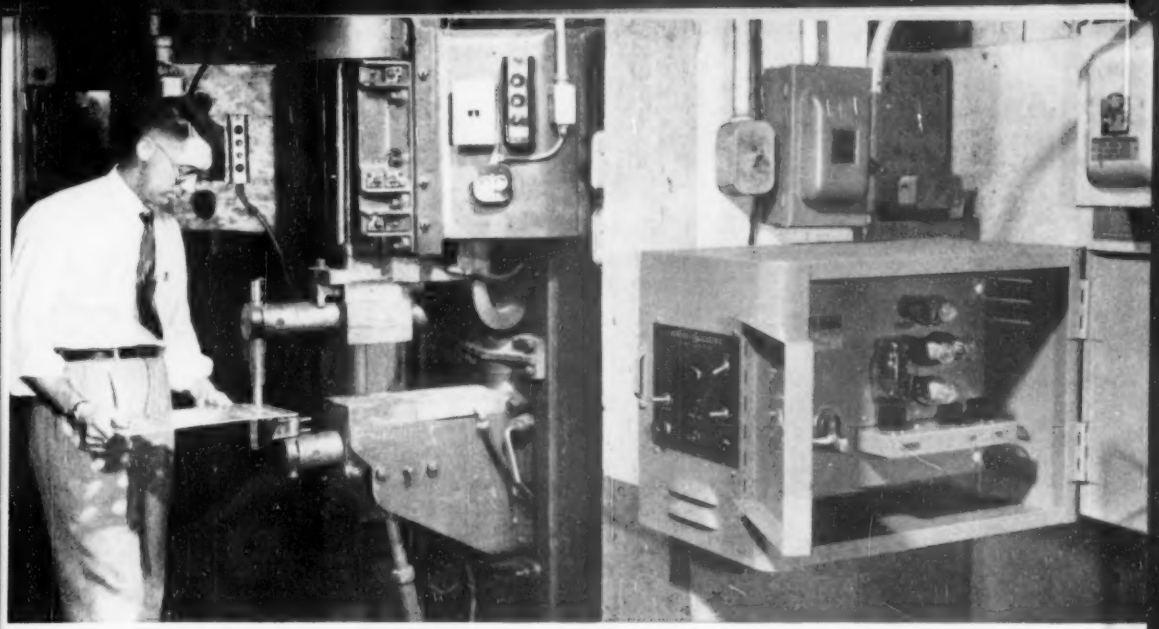
► **Link Aviation, Inc.**, Binghamton, N. Y., has subcontracted part of its C-11B jet flight trainers contract to Wurlitzer Co., Tonawanda, N. Y. The C-11A trainer is being used in combat pilot training in Korea.

► **Northrop Aircraft, Inc.**, Hawthorne, Calif., has granted an exclusive license to Narmco Resins and Coatings Co., Costa Mesa, Calif., to manufacture and market a metal-plastic adhesive for bonding Northrop Styrofoam.

► **Simmonds Aerocessories, Inc.**, Tarrytown, N. Y., has commenced construction on a new plant in Vergennes, Vt., for precision manufacture of aircraft electronic and mechanical equipment.

► **The University of Wichita**, Wichita, Kan., has started construction of a new engineering building having 25,000-sq. ft. of floor space which is scheduled for completion in time for fall classes in 1953.

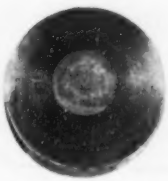
► **North American Aviation, Inc.**, Los Angeles, has leased a new 134,000 sq. ft. building in East Los Angeles near



Laboratory Tests Prove Resistance Welding Aluminum Is Easier with . . .

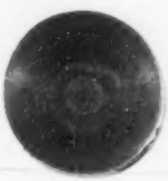
NEW G-E UP-DOWN SLOPE CONTROL

WITHOUT SLOPE CONTROL



ELECTRODE PICKUP is noticeable on this electrode, used 40 times without Slope Control.

WITH SLOPE CONTROL



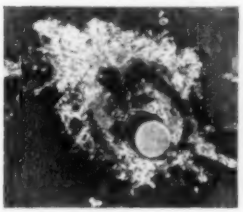
LONGER ELECTRODE LIFE with G-E control. Above used on aluminum 1700 times—no cleaning.

HOW IT WORKS: This new G-E control increases heat input gradually (Up-Slope) to full-heat, reducing tip pickup. After full-value time has elapsed, heat is gradually decreased (Down-Slope), reducing porosity and cracking.

UNIFORM WELD STRENGTH is obtained only with G-E control because precision timing is used at point where Down-Slope starts.

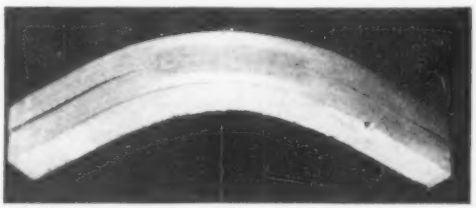
For more information on the complete line of G-E resistance welding control, contact your nearest G-E apparatus sales office. Write Section 645-57 for bulletins GEC-902 and GER-610 on Up-Down Slope Control.

Your resistance welding machine manufacturer or his agent will be glad to help you with resistance welding problems. *General Electric Company, Schenectady, N. Y.*



SEVERE BURNING caused by current surge in welding aluminum without Slope Control.

NO BURNING when G-E Slope panel automatically controls heat input in stud-welding aluminum.

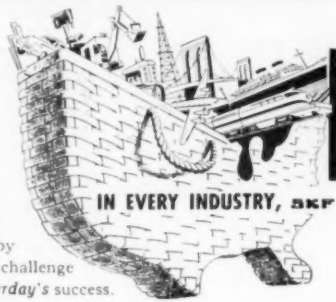


DUCTILE WELDS, such as this aluminum alloy nugget bent 45°, show no cracks because of the tempering effect of gradually decreasing heat input. This means fewer rejects.

RESISTANCE WELDING CONTROL

GENERAL ELECTRIC

RUNGS OF RESEARCH



Day in, day out, sees further advances in aircraft speed . . . safety . . . operating efficiency. To help the aircraft industry "climb the ladder to the stars," SKF engineers are constantly designing, developing, and improving ball and roller bearings so they will have the stamina to withstand the tremendous punishment dealt them by supersonic aircraft. To SKF, the aircraft-challenge of *tomorrow* is more interesting than *yesterday's* success. It's all a part of SKF's relentless program of working for ever-higher quality standards—setting the pace for bearing manufacturing. **SKF INDUSTRIES, INC.,** PHILA. 32, PA.—*manufacturers of* **SKF** *and* HESS-BRIGHT *bearings.*

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Downey, Calif., for work on rocket engines for long-range guided missiles.

► **Sperry Gyroscope Co.**, Great Neck, N. Y., has opened a field service subdistrict office in Miami at 904 N.E. 2d Ave.

► **AiResearch Manufacturing Co.** of Phoenix, Arizona, has started production of air turbine starters in its new $5 million plant.

► **Stronghold Screw Products, Inc.**, Chicago, has purchased a building with 80,000 sq. ft. of space in Chicago to double present manufacturing capacity.

► **The Ramsey Corp.**, St. Louis, manufacturer of piston rings, has purchased the Chemical division of Maplewood Products Corp., St. Louis, maker of Ramco 3-Up parts cleaner.

► **Montgomery Engineering Co.**, Detroit, has moved its offices, shop and warehouse from 14101 Prairie St. to 8500 Twelfth St., at corner of Philadelphia.

► **Standard Pressed Steel Co.**, Jenkintown, Pa., has received a USAF contract for 2,000 work benches.

► **British European Airways Corp.** has appointed A. E. Ulmann & Associates, 342 Madison Ave., N. Y., as sole purchasing agents in the U. S., Canada and South America, of equipment and spares for its Douglas C-47, Sikorsky S-51 and Bell 47-B3 aircraft.

► **Douglas Aircraft Corp.** has licensed Resistoflex Corp., Belleville, N. J., to manufacture Teflon spiral back-up washers.

USAF CONTRACTS

Following is a list of USAF contracts recently announced by Air Materiel Command:

American Machine & Metals, Inc., U. S. Gauge division, Sellersville, Pa., transmitters hydraulic pressure, 6,965 ea.; transmitters hydraulic pressure, 154 ea.; transmitters hydraulic pressure, 1,314 ea., $86,024.

Appie Textile Mfg. Inc., W. A., 217 Washington Street, Dayton, tow target, 12,173 ea., $250,886.

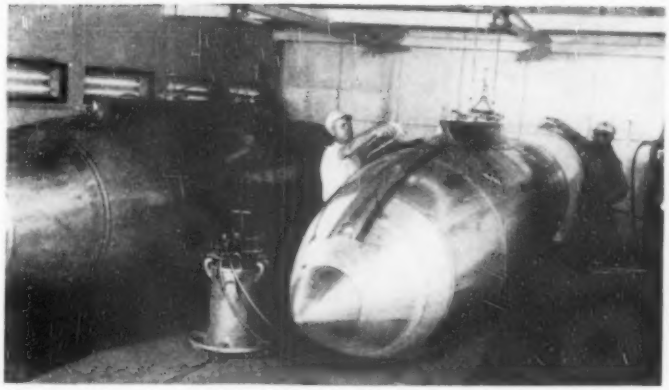
Audio Products Corp., 2265 Westwood Blvd., Los Angeles, radar sets, 77 ea., radar sets, 27 ea., maintenance spare parts, 1 lot, $82,146.

Aero Test Equip. Co., Inc., 8531 Joyce Way, Dallas, stand, assembly generator control and data, 75 ea., $397,742.

American Bosch Corp., 3564 Main St., Springfield, Mass., starters, 8,697 ea., $197,-270.

Anaheim div., Robertshaw-Fulton Controls Co., Anaheim, Calif., valves, 74 ea., $200,000.

Boeing Airplane Co., Seattle, kits MCR 8518, 153 ea., kits MCR 8519, 186 ea., $232,654.



RUBBER-BASED SPRAY helps give Ryan's B-47 external tanks "aerodynamic" finish.

Smooth Is Word for B-47 Tanks

The world's largest external fuel tanks—for Boeing's B-47 Stratojet—are getting an "aerodynamic finish" to fit them for the plane's highspeed role.

Ryan Aeronautical Co., San Diego, fabricator of the tanks, surface-treats the huge fuel containers so that they will have a minimum of drag.

There are no joining protuberances—more than 30,000 spotwelds give the tank an initial smoothness. After this, thinner and alcoholic phosphoric acid solution is used to clean and slightly etch the aluminum alloy surface to insure good adherence for the primer. Next a coat of zinc chromate solution is sprayed on, followed after quick drying by a spray of special synthetic rubber-base compound. This last application not only gives an "aerodynamic" coat, but the material is also resistant to aromatic fuels and is rain erosion-proof at high speeds, Ryan reports.

A final smoothness is imparted to the rubber-base coat by wet-sanding and hand-rubbing.

Belmont Radio Corp., 59-21 W. Dickens Ave., Chicago 39, indicators, 67 ea., rectifiers, 67 ea., $89,466.

Continental Aviation & Engineering Corp., Detroit, auxiliary power unit, 9 ea., auxiliary power unit, 1 ea., auxiliary power unit, 9 ea., $953,754.

Consolidated Radio Products Co., 359 W. Erie St., Chicago, magazine aircraft camera, 560 ea., $174,273.

Curtiss-Wright Corp., Electronics div., Carlstadt, N. J., trainer, spare parts, 48 ea., $2,126,088.

Detecto Scales, Inc., 540 Park Ave., Brooklyn, N. Y., scale, 102 ea.; data, 301 sets, $27,813.

Dupont de Nemours & Co., Inc., E. I., Photo Products Dept., Wilmington, Del., photographic film & paper, $1,586,678.

C & F Manufacturing Co., 21630 Wyoming St., Detroit, platform assembly, 216 ea., $332,192.

Eclipse-Pioneer div., Bendix Aviation Corp., Teterboro, N. J., 500-va. inverters, 628 ea., 316 ea., $460,729.

Eicor, Inc., 1501 W. Congress St., Chicago, inverters, data & spare parts, 200 ea., $234,554.

ETC Inc., 1549 Lake St., Niles, Mich., solenoids, 92,728 ea., $175,075.

Fairchild Camera & Instrument Corp., 88-06 Van Wyck Blvd., Jamaica, N. Y., shutter assembly, 125 ea., $49,171.

Fletcher Aviation Corp., 190 W. Colorado St., Pasadena, fuel tanks, 6,828 ea., $203,-261.

Gavveo Laboratories, Inc., 540 E. 80 St., New York, exciter regulators, 516 ea., 339 ea., 1,844 ea., $1,159,230.

General Electric Co., 1 River Rd., Schenectady, N. Y., power supplies, 128 ea., $42,-620; Indicator, 1,514 ea., $141,820.

Graybar Electric Co., 352-42 W. Monument Ave., Dayton, steel bar, 5 ea., benteye bolt, 4 ea., rack, cable, 45 ea., $78,253.

Hammond Mfg. Co., Pasadena, truck, 2,248 ea., $69,463.

Hazeltine Electronics Corp., 58-25 Little Neck Parkway, Little Neck, L. I., N. Y., indicator group, 450 ea., $6,942,080.

Hallamore Mfg. Co., 2001 E. Artesia St., Long Beach, Calif., transmitter, 12 ea., carrier monitor system, 12 ea., air ground operation control, 56 ea., $379,544.

Houston-Fearless Corp., 11801 W. Olympic Blvd., Los Angeles, paper processing machine, $38,365.

Heiliofer-Castellini, 414 W. First St., Dayton, furnish & installation of electrical power & distribution equipment, $148,352.

Holley Carburetor Co., 5930 Vancouver Ave., Detroit, misc. carb spare parts, $32,854.

Hunt Co., Philip A., Palisades Park, N. J., photographic chemicals, $136,612.

Jack & Heintz, Inc., Cleveland, starters, 283 ea., $124,902.

Keystone Watch Case div., The Riverside Metal Co., Riverside, N. J., indicator, position, landing gear, 7,666 ea., $76,361.

Marion Screw Products Co., 327 North Boots St., Marion, Ind., head, pilot bomb sight, 380 ea., $28,389.

Maurer, Inc., J. A., 37-01 31st St., Long Island City, N. Y., aircraft cameras, data and spare parts, 36 ea., $184,140.

Nickel Cadmium Battery Corp., 100 Park Ave., New York, nickel-cadmium control batteries, 40 ea., battery racks, 40 ea., spare components, $62,238.

Northrop Aircraft, Inc., Hawthorne, Calif., airplanes, 172 ea., spare parts, tools and equipment, data, training parts, monthly progress reports, engineering changes, $142,913,250.

Philadelphia div., Yale & Towne Mfg. Co., Philadelphia, trucks, 31 ea., spare parts, 1 lot, engineering data, 1 set, $270,748.

Radio Corp. of America, RCA Victor div., Camden, N. J., radio set, spare parts & data, 1 ea., $642,000.

Robertshaw-Fulton Controls Co., Thermostat division, Youngwood, Pa., indicators, 5,126 ea., $1,193,614.

RCA Victor div., Radio Corp. of America, Camden, mobile radio transmitter, 84 ea., fixed receiver transmitter, 9 ea., spare parts base unit, 3 groups, $36,913.

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Republic Aviation Corp., Farmingdale, L. I., N. Y., XF-84H airplanes, 2 ea., $500,000.

Republic Aviation Corp., Farmingdale, L. I., N. Y., airplanes, spares, special tools and data, 80, $5,500,000.

Spar Engineering & Development, Inc., South & Paxson Aves., Wyncote, Pa., racks and components for oscillograph, $44,741.

Standard Products Co., 4001 Main St., Philadelphia, photographic chemicals, 22 items, $29,121.

Recordak Corp., 444 Madison Ave., New York, photographic microfilm, $29,652.

Reynolds Metals Co., 2500 S. Third St., Louisville, Ky., aluminum sheet, 371,000 lb., $154,951.

Rosen, Raymond, Engineering Products, Inc., 32 & Walnut Sts., Philadelphia, telemetering equipment, $51,887.

Ryan Industries, Inc., 19159 John R. St., Detroit, rate of climb indicators, 6,644 ea., $795,204; dispenser set, 1,258 ea., maintenance spare parts, 1 lot, maintenance data, 3 sets, $482,581; retrofits, 126 ea., $364,357.

Spring Chemicals Inc., 4124 Park Ave., Bronx, N. Y., photographic chemicals, $27,767.

Standard Electrical Products Co., 2240 E. Third St., Dayton, resistors, 536,510 ea., $25,166.

Summers Fertilizer Co., Inc., 210 E. Redwood St., Baltimore, fertilizer, 1,215 tons, 3,850 tons, $223,565.

Sunbeam Corp., 5600 Roosevelt Blvd., Chicago, airspeed indicators, 2,779 ea., $491,525.

Superior Electric Co., Bristol, Conn., voltage regulators, 86 ea., $46,640.

Surprenant Mfg. Co., 199 Washington St., Boston, wire-elec. insulated, 1,117,000 ft., $53,651.

Taffet Radio-Television Co., 2530 Belmont Ave., New York, interphone control, 2,080 ea., $79,790.

Technical Material Corp., 121 Spencer Place, Mamaroneck, N. Y., plug-in coil drawers, 394 ea., $38,291.

Tenaer Electric Development Co., 343 Classon Ave., Brooklyn, N. Y., connector, 10,630 ea., $28,543.

U. S. Gauge division, American Machine & Metals, Inc., Sellersville, Pa., transmitter, torque pressure, $217,933.

Wright Aeronautical div., Curtiss-Wright Corp., Wood-Ridge, N. J., special tooling, $9,000,000.

White-Rogers Electric Co., 1209 Cass Ave., St. Louis 6, actuators, 474 ea., $96,725.

X-Ray Dept., GE Co., 4855 Electric, Milwaukee, photographic chemicals, $79,199.

York Corp., 659 East Sixth St., Cincinnati, materials & services, 3 pr., $36,359.

United Aircraft Corp., Sikorsky Aircraft division, Bridgeport, Conn., spares for aircraft, $75,000.

Western Electric Co., Inc., 195 Broadway, New York 7, N. Y., jack mounting, 80 ea., $81,264.

Waco Aircraft Co., Troy, Ohio, kit spares, 252 ea., $489,086.

Wilcox Electric Co., Inc., 14th & Chestnut, Kansas City, Mo., HF and VHF transmitters, spare parts kits, remote control units, $807,826.

Wiekes Engineering & Construction Co., 12 St. & Ferry Ave., Camden, N. J., amplifier, 4,000 ea., $185,173; FRC-19A components, $34,540.

Wilcox Electric Co., Inc., 14th & Chestnut, Kansas City, Mo., multi-frequency transmitters, 125 ea., $973,625.

Wire & Cable div., Electric Auto-Lite Co., 3529 24 St., Port Huron, Mich., wire-electric, 4,672,000 ea., $122,896.

Wisconsin Motors Corp., Milwaukee, spare parts, lot, $51,315.

Wollensak Optical Co., 850 Hudson St., Rochester, N. Y., motion picture cameras, 25 ea., motion picture cameras, 2 ea., motion picture cameras, 10 ea., motion picture cameras, 8 ea., control unit, 18 ea., $84,112.

Worthington Corp., 812 Race St., Cincinnati 2, compressors & spare parts, 644 ea., $1,181,688; portable air compressors, 60 ea., $69,840.

Wright Aero div., Curtiss-Wright Corp., Wood-Ridge, N. J., engine crankshafts, 605 ea., $436,022.

Ypsilanti Machine & Tool Co., Ypsilanti, Mich., item 1 F-2 heater, 2, spare parts, 3 data, 2,946 ea., $225,642.

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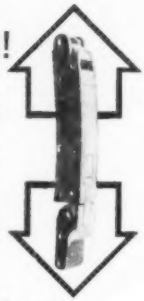

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AVIATION SAFETY

CAB Accident Investigation Report

Robin's C-46 Was Flying Too Low

The airline and the pilot were at fault in the crash of a Robin Airlines' C-46 near Whittier, Calif., Apr. 18, 1952, with the death of all persons aboard—26 passengers and three crew, according to the Civil Aeronautics Board's official report.

The pilot is blamed for taking the plane below the minimum altitude for which he was cleared. Apparently he had brought the plane down to make a visual approach to Los Angeles International Airport under the overcast which had developed. Weather conditions were satisfactory at Los Angeles for an ILS approach, for which the pilot had been cleared, the report says, but they were not suitable for a visual approach.

The command pilot on this flight, Capt. Lewis R. Powell, was serving contrary to a restriction placed on him by his medical certificate. He had suffered a severe heart attack on Mar. 30, 1951. Although he had recovered, according to his physician, CAA had limited his certificate to check pilot duties.

The report points out, however, that the certificate may be so folded as to conceal the limitations information.

The complete CAB report:

THE ACCIDENT

At approximately 0334 PST[1] Apr. 18, 1952, a C-46 aircraft, N 8404C, crashed and burned near Whittier, Calif., resulting in destruction of the aircraft and death of all persons aboard—26 passengers and three crew members. The aircraft was operated by Robin Airline, Inc.,[2] an irregular carrier, under a lease agreement with its recorded owner, Air Charters, Inc., of Carson City, Nev.

HISTORY OF THE FLIGHT

N 8404C departed New York, N. Y., at 1909, Apr. 16, as Trip 416W. After making a scheduled stop at Chicago, Ill., it arrived at Kansas City, Mo., at 0208, Apr. 17. At this point the flight was taken over by a new crew consisting of Capt. Lewis R. Powell, Reserve Capt. John D. Treher, Copilot Charles K. Waldron, and Hostess Dolores A. Bradford. The flight time requirement specified by the Civil Air Regulations (Part 42.48) made it necessary to have a three-man flight crew between Kansas City and Burbank because of the expected flight time involved. For this purpose Reserve Capt. Treher had deadheaded from Chicago to Kansas City.

Departure from Kansas City was delayed approximately 11 hr. when it was found necessary to replace the right engine oil cooler which had developed a leak. The flight departed Kansas City on a VFR (visual flight rules) flight plan at 1338, with Reserve Capt. Treher occupying the left pilot seat and Copilot Waldron, the right. Capt. Powell occupied a seat in the main cabin.

A precautionary landing was made at Wichita, Kan., at 1500, to check oil consumption, which was found to be normal, and the flight departed at 1534 on an IFR (instrument flight rules) flight plan, with Capt. Treher still flying the aircraft. Upon arriving in the vicinity of Tucumcari, N. M., a severe thunderstorm condition was encountered, whereupon the flight turned eastward and landed at Amarillo, Tex., at 1814. Reserve Capt. Treher deplaned at this point, and at 2102 the flight again proceeded westward on an IFR flight plan to Phoenix, Ariz., with Capt. Powell occupying the left pilot seat and Copilot Waldron still occupying the right.

At 2235 the flight reported over Albuquerque, N. M., and at this point changed from an IFR to a DVFR (defense visual flight rules) flight plan, estimating Phoenix at 0020. It arrived at Phoenix at 0030, Apr. 18, deplaned three adult passengers and one infant, and departed there at 0143 on a DVFR flight plan to cruise at 8,000 feet, Green 5 airway, to Riverside, Calif., then direct to Burbank, Calif., the destination.

At 0313 the flight requested and was furnished the Burbank and Los Angeles 0228 weather, which was as follows: Burbank closed, visibility ¼ mi., and Los Angeles measured 700 overcast, visibility 2½ with haze and smoke, temperature 57°, dew point 54, wind southeast 1, altimeter 29.91. At this time the flight advised it would file an IFR flight plan later. At 0317 the flight reported over Riverside Range Station at 6,000 feet and requested an IFR approach to Los Angeles, estimating over Downey at 0336. The Los Angeles low-frequency radio range was not in operation, which fact was known to the pilot. At 0323, ARTC (air route traffic control) gave the following clearance to the aircraft: "From present position to Downey radio beacon cruise at least 500 on top—Descend VFR and cross Downey and maintain 3,000—Contact Los Angeles Approach Control over LaHabra—No delay expected." The pilot repeated this clearance.

The following information concerning the handling of this flight is taken from the report of the Los Angeles Airport Chief Traffic Controller:

"At 0333P, N-04C called Los Angeles Approach Control on 119.9 mc. (very loud

[1] All times referred to herein are Pacific Standard and based on the 24-hour clock.

[2] At the time of this accident Robin Airlines, Inc., was (doing business as) North Continent Airlines, although no authorization to change its name had been obtained from the Civil Aeronautics Board.

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and clear) advising he believed he was in the vicinity of La Habra and was having difficulty with his ADF equipment account static and that he would have to make some other type of approach. The Approach Controller asked N-04C if he had ILS equipment and whether he believed he could pick up the outer marker satisfactorily. The pilot answered in the affirmative and further stated that he could probably find the ILS Glide Path and proceed from there on in. N-04C was then cleared (0333P) for a straight-in ILS approach from Los Angeles Outer Marker and given the current Los Angeles weather and also advised that the Los Angeles L.F. Range was inoperative account being shut-down for maintenance.

"The Los Angeles Approach Controller then immediately began watching for N-04C's appearance within the next few minutes on the Surveillance Radar Scope on the normal setting of 20-mi. range as the flight continued westbound toward the Los Angeles Outer Marker. When no target appeared on the Surveillance Scope by 0337P several radio calls were directed to N-04C by Los Angeles Approach Control. No response was received. * * *"

About 1000 the morning of Apr. 18, Mr. Hayden Jones, a rancher of Puente, Calif., came upon the wrecked aircraft about 2 mi. east of Whittier and 22½ mi. east-northeast of the Los Angeles International Airport.

INVESTIGATION

The accident occurred near the top of a grassy knoll at an altitude of 980 ft. MSL while the aircraft was banked slightly to the left, probably level longitudinally, and on a heading of 260° magnetic. This site is approximately 2,600 ft. north of the center line of the ILS approach path to Los Angeles International Airport, slightly west of north of La Habra, and about 7½ mi. east of the Downey fan marker.

Evidence indicated that the power plants were operating normally and that both were developing appreciable power at initial impact. Following first ground contact, the aircraft continued airborne for a distance of 1,875 feet across a ravine, where it crashed and burned on the upslope of the opposite side.

Examination of the wreckage revealed that at initial impact with the ground the landing gear was in the extended position and the wing flaps were fully retracted. No evidence was found to indicate that any structural failure or malfunctioning of the aircraft and power plants, or of any of their components, had occurred prior to the accident. As far as could be determined from examination of the wreckage and a review of the maintenance records, the aircraft was well maintained and was in an airworthy condition when it crashed.

Damage to the cockpit section was so extensive that no reliable readings could be made of most of the instruments or control settings. The barometric scale of each of the altimeters was set at 29.89. Examination of the aircraft clock disclosed that although the hour hand was loose on the shaft, the minute hand was stuck at approximately 33:45 and the second hand at :45.

The latest weight and balance report obtainable was the one out of Kansas City, which indicated a gross weight of 44,952

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lb., including 1,315 gal. of fuel. This was within the allowable gross of 45,000 lb. It was impossible to locate a manifest out of Phoenix, a copy of which should have been mailed to the company's headquarters in accordance with the Civil Air Regulations. At Amarillo, 606 gal. of fuel and 32 qt. of oil were added. Using the basic weights out of Kansas City and estimating 150 gal. per hour fuel consumption (normally used for C-46 flight planning purposes) with 17 gal. per stop allowed for taxiing and warm-up, the aircraft is calculated to have departed Phoenix with a gross weight of 40,542 lb., including 715 gal. of fuel. At the time of the accident, approximately 422 gal. of fuel remained.

Nearly all of the radio equipment was destroyed by the impact and subsequent fire. It was determined, however, that the ILS Control Head was positioned to Channel (Y), corresponding to the Los Angeles ILS frequencies, and that the ADF was tuned to approximately 260 kc. The Los Angeles ILS outer marker operates on a frequency of 266 kc. According to company maintenance records, all radio equipment had been overhauled, establishing ZERO service time. It was then installed on this aircraft Mar. 25, 1952. The ADF was suitably compensated Apr. 3, 1952.

All radio contacts with the flight were normal, the last one at 0333 being reported as, "very loud and clear." The only irregularity mentioned by the flight crew was the difficulty with the ADF equipment because of static. The Airways Flight Inspection Branch of CAA, on Apr. 18, made a special check of the Los Angeles instrument landing system and the La Habra and Downey fan markers. The report on this check indicated that operation of these facilities was normal in all respects.

Information given the crew at Phoenix showed clear weather for the remainder of the flight, with the exception of the immediate vicinity of Los Angeles where Burbank was forecast to be zero-zero with fog, and the Los Angeles Airport 800 ft. and 2 mi. with fog and haze, at the time of the flight's anticipated arrival there.

During the last leg of the flight, Phoenix to Los Angeles, it appears that clear sky and excellent flying conditions existed as far as Pomona, Calif. At the time of the accident the weather at Los Angeles Airport was reported to have been ceiling 700 ft., overcast, visibility 2½ mi. with haze and smoke; and Burbank ceiling 100 ft., sky obscured, visibility ½ mi. with fog. The stratus and fog had been spreading inland and at the time of the accident apparently included the cities of Whittier and Puente, and the adjacent hills. The top of the stratus ranged from about 1,200 to 1,500 ft. and it is indicated that the west slopes of the Puente hills, including the tops of the ridges and site of the crash, were in the fog at the time of the accident; however, it was clear immediately to the east of these hills. Aircraft icing conditions did not exist and turbulence, if any, would have been negligible.

On the morning of Apr. 18, shortly after 0330, a farmer and his wife, living on a hill approximately 500 ft. above sea level and about 2½ mi. in a northwesterly direction from the scene of the accident, were disturbed by a plane flying very low over their

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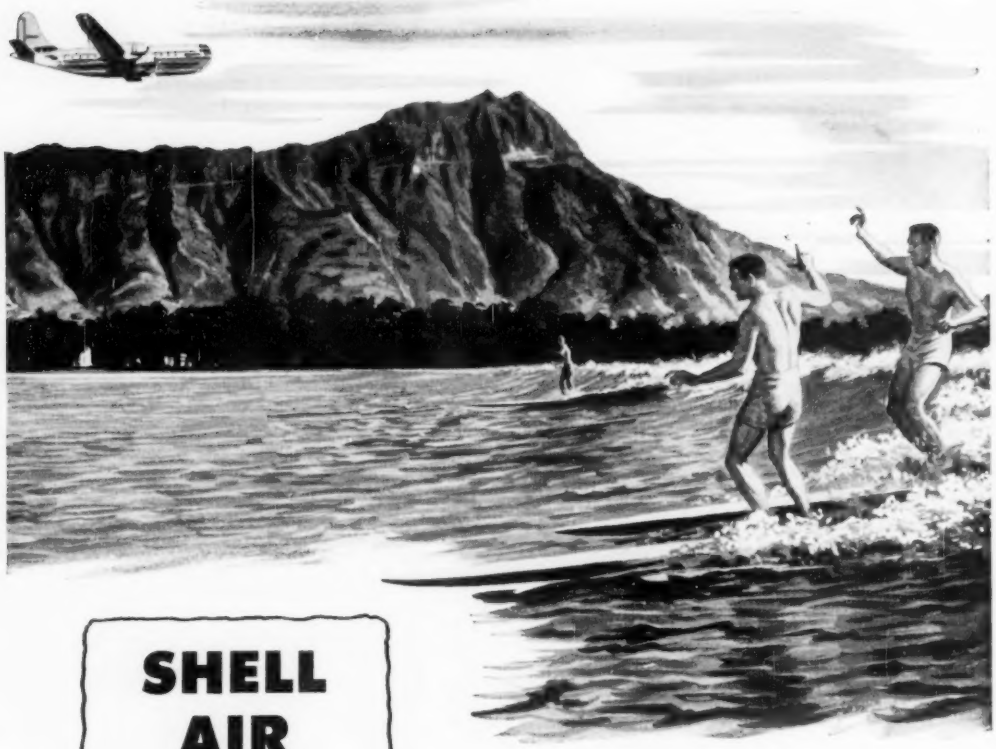

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home. Getting out of bed, they saw through a window the flashing lights of a low-flying airplane headed in a westerly direction. The plane continued in this direction until out of sight but not out of hearing. Without again seeing the plane they heard it returning, headed easterly, in which direction it continued until beyond their range of hearing. No aircraft other than the one that crashed are known to have been in this area at that time.

Capt. Lewis Reed Powell had been actively engaged in aviation for a number of years and had accumulated 7,751 hours of flying time when he became physically incapacitated on Mar. 30, 1951, by a coronary attack. This flight time included, as captain, 1,500 hr. in DC-3s, 1,900 in DC-4s, and 600 in C-46s. He was issued Airline Transport Rating No. 61564 in Dec., 1945. This rating was reissued Dec. 23, 1951, after he had completed a rating and equipment check in DC-3 aircraft given by a CAA designated flight examiner.

The heart attack suffered by Mr. Powell on Mar. 30, 1951, was of such severity that his physician immediately sent him to a hospital in an ambulance, under oxygen. His condition improved sufficiently for him to be taken home by ambulance on Apr. 13, but he was confined to bed for an additional six weeks, following which activity was slowly and gradually resumed. He remained under medical care as an office patient until December 1951, and was last seen by his physician on Apr. 12, 1952. His physician stated that he responded well to treatment and made an uneventful recovery.

On Sept. 1, 1951, Capt. Powell visited Dr. Francis C. Herzog, the CAA-designated medical examiner from whom he usually took his pilot physical examinations. Although Dr. Herzog found no physical irregularities in this examination, when Capt. Powell, in response to a question, stated that he had had a heart attack since his last CAA physical, the examiner told him he could not issue a medical certificate as the matter would require a decision by the CAA Regional Medical Officer. Capt. Powell was then requested to obtain an electrocardiagram and a letter from his personal physician for forwarding to the CAA Regional Medical Officer.

Upon receipt of this information the Acting Regional Medical Officer, Dr. Fred M. Ellis, referred the case to the CAA Medical Standards Branch, Washington, D. C., and received the following reply, dated Oct. 23, 1951, "The case of Lewis Reed Powell, aged 45, shows definite evidence of posterior myocardial infarct and definite history. I believe that any of these cases should be denied any class of certification, including Mr. Powell."

Dr. Ellis then wrote Dr. Herzog as follows, on Nov. 14:

"This letter is intended to complete your record for Mr. Lewis Reed Powell.

"Dr. John Smith in our Washington office felt that Mr. Powell, like others who have coronary artery disease, should not be certified for solo or pilot in command flying. I have given Mr. Powell a Class One certificate with the following limitation, 'Valid for Company Check Pilot Duties.'

"Mr. Powell has spent considerable time trying to convince me that our policy regarding coronary artery disease is unfair. He was not successful.

"I have suggested that he visit Dr. Smith in Washington for a cardiac survey. I believe that he will do this.

"I am sincerely sympathetic with Mr. Powell's occupational catastrophe; however, I am convinced that coronary artery disease and pilot responsibility are incompatible."

On Nov. 14, 1951, Captain Powell was

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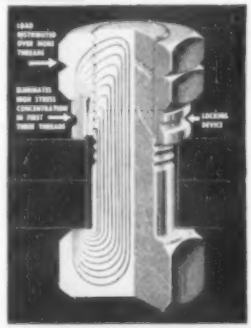

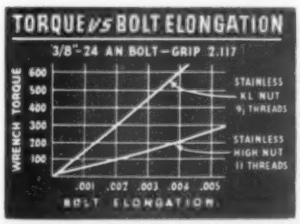

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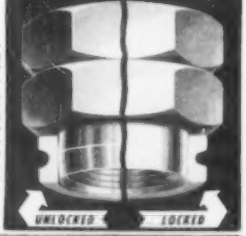

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issued a first-class medical certificate, dated Sept. 1, 1951, with the limitation, "Valid for Company Check Pilot Duties." When Capt. Powell was examined Mar. 14, 1952, for renewal of his medical certificate, Dr. Herzog again found no physical irregularities but because of the pilot's heart history, issued a medical certificate with the same limitation as before.

Mrs. Powell, widow of Capt. Powell, was unable to testify at the accident investigation hearing. However, her statement was taken later, at which time she stated that both she and Capt. Powell were well aware of the limitation on Capt. Powell's medical certificate, as was an official of another irregular carrier for whom Capt. Powell made two trips in Dec. 1951. She stated further that Capt. Powell told her he was not discussing the limitation on his certificate with any of the other pilots, as he hoped to go to Washington and have the limitation removed.

Capt. Powell made application for employment as a pilot with Robin Airlines on Dec. 22, 1951, and on Dec. 23 successfully passed an equipment and rating check in DC-3 aircraft, given by C. A. Rector, then director of Operations for Robin Airlines and a CAA designated check pilot. Powell was hired by Robin Airlines on Feb. 20, 1952, and on Feb. 23 was given a preassignment check by C. A. Rector in C-46 equipment. He was assigned as a copilot and made his first flight for the company on Feb. 24 Burbank-Oakland-Burbank, in a C-46. From the time he was employed by Robin through Mar. 31, Powell made nine flights as copilot—four in C-46s and five in DC-3s; four flights as co-captain—one in a C-46 and three in DC-3s; and two flights as reserve captain, both in DC-3s. On Apr. 1 he passed an equipment and rating check in the C-46, given by CAA Designee William H. Butler, with a below average grade of 75%, and on that date was assigned as captain by Robin Airlines.

From Apr. 1 until Apr. 18, the date of the accident, Powell made nine flights as captain in C-46 equipment. With the exception of two trips between Burbank and Oakland, all of his flights for Robin Airlines were between Burbank and Kansas City. All of the passenger-carrying flights made by Powell were contrary to the limited medical certificate which restricted him to company check pilot duties.

Company officials testified that prior to the accident they were not aware of any limitation on Capt. Powell's medical certificate, although they had examined his pilot papers on more than one occasion. CAA Designee Butler, who gave Powell his C-46 equipment check on Apr. 1, testified that he, too, looked at Powell's pilot papers, including his medical certificate, and was aware of no medical limitation. He stated further that he was sure he would have noticed the statement under "limitations" because it would be so unusual.

On Mar. 11, CAA Aviation Safety Agent G. O. Trapp ran a ramp check at Amarillo on a flight on which Powell was a crew member. He stated in his report that Powell did not possess the required airman identification card. Mr. Trapp did not testify at the Board's accident investigation hearing but a statement was obtained from him later, in which he stated that he examined Powell's medical certificate during the ramp check and noted no limitations. This is understandable if the medical certificate was folded when it was examined. It has been demonstrated that a medical certificate can be so folded and placed in a container that while all other pertinent information can be easily read, that portion relating to limitations can be concealed. In addition, the specific wording of the limitation was such as not to indicate clearly and unambiguously the fact that it was intended to be a limitation to acting solely as a check pilot and in no other capacity, but was at least susceptible of the construction that it represented an addition authorization.

The waiver clause in Part 29 of the Civil Air Regulations is designed for use where a pilot's experience, ability, and judgment compensate for physical deficiency. However, no amount of experience, ability, and judgment can compensate for an organic disease which may, at any time, completely incapacitate the pilot. Hence the finding required by Section 29.5 before a waiver is granted could not be properly made in this case. We have, therefore, requested the Administrator of Civil Aeronautics to take specific steps to prevent recurrence of such a situation as arose in the case of Capt. Powell.

According to testimony of Dr. Ellis, the acting CAA medical officer of Region VI, the intent of the limitation placed on this medical certificate was to restrict Powell to company check pilot duties *only* and he was not to fly solo, as pilot in command, or as a copilot. Capt. Powell was fully aware of

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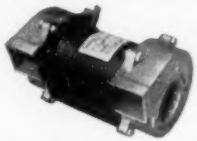

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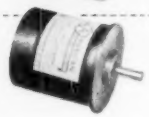

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the intent of this medical limitation. Dr. Ellis testified that Powell spent several hours with him at the time the medical certificate was issued, discussing the significance of the limitation and trying to persuade him to issue the certificate without it. The record also shows that Mr. Frank Allen, then Chief, Safety Operations Division, CAA Region VI, also knew of the limitation, and that he had discussed it with both Capt. Powell and Dr. Ellis.

The autopsy surgeon reported he found definite evidence that Capt. Powell had a badly damaged heart and that he had had a recent hemorrhage. While he could not determine whether or not death had occurred before the crash, he did state that this hemorrhage had occurred within, "probably a matter of hours, at the outside. It could have been immediately before or it could have been a matter of several hours before."

Robin Airlines' ground training program for pilots is handled under contract by Fowler Aeronautical Service at Burbank. A description of that training program was given in the Board's report issued July 16, 1952, covering the forced landing involving this carrier at Cobourg, Canada, Dec. 20, 1951.

During the period of approximately two months that Powell was in the employ of Robin Airlines, he received and completed two of Fowler's source material reviews—one with a grade of 100%, the other with 90%. In addition, he had one-half hour of Link instruction in March, which was discontinued because of mechanical difficulty with the equipment.

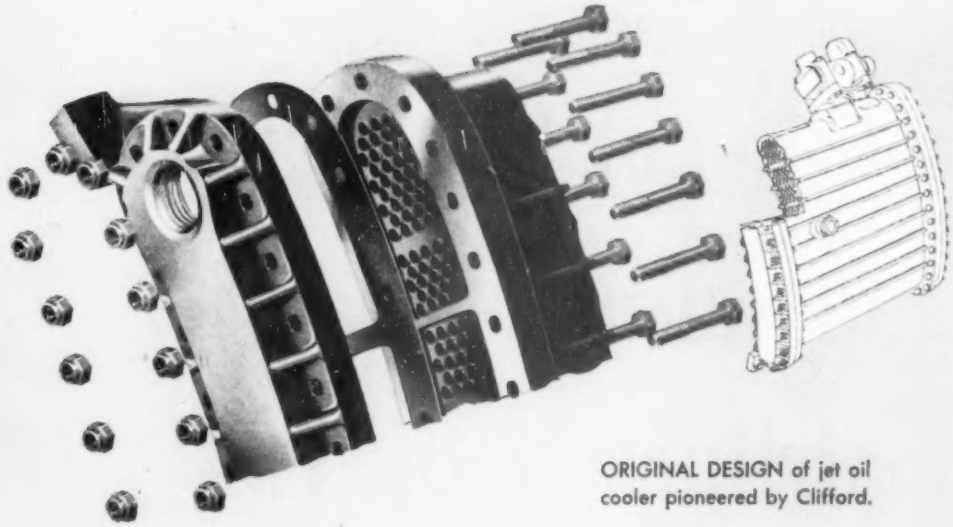
Company records indicated that Copilot Waldron was sent one of these source material reviews after he started working for Robin Airlines on Apr. 1 however, there was nothing to indicate that he had either received or completed it. On Apr. 1, Waldron was given a pre-assignment instrument and equipment check flight in a C-46 by CAA Designee Butler, after which time he was assigned by Robin Airlines as a copilot.

ANALYSIS

Since examination of the wreckage and review of maintenance records did not reveal any evidence of failure or malfunctioning of the aircraft or power plants or of any of their components prior to the crash, and since no mechanical difficulty was reported in any of the radio contacts with the flight, it must be concluded that the cause of the accident was operational rather than mechanical.

Based on the known fuel aboard when the flight departed Kansas City and that taken aboard at Phoenix, it is evident that there was sufficient fuel for the flight to have remained in the air from two to three hr. longer had the crew considered it necessary or advisable. It is also apparent that at initial impact with the ground the aircraft was in controlled flight with both engines operating at appreciable power.

The aircraft had ample radio equipment and all contacts, the last of which was just a few seconds before the crash, were reported to have been "loud and clear." It could not be determined whether these contacts were made by the captain or the copilot. Moreover, nothing was said or otherwise noted to indicate that the flight was in any



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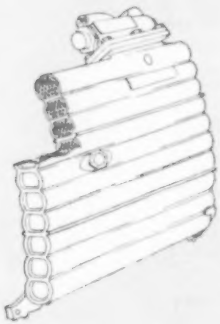

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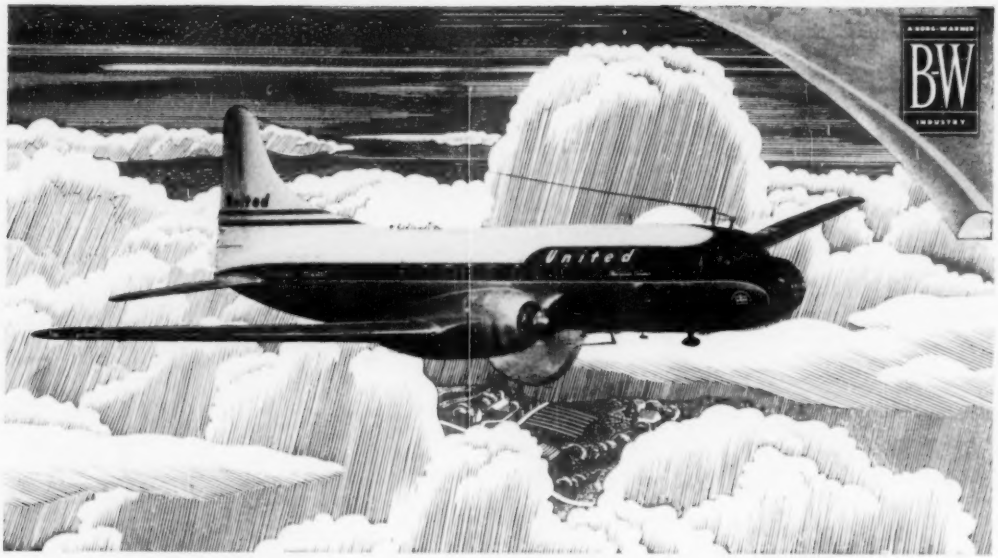

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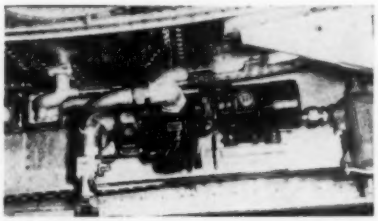

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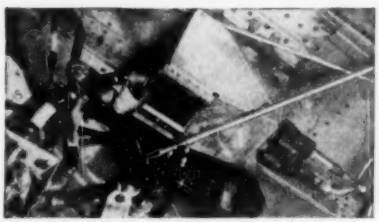

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difficulty, or that things were other than normal, and the flight appears to have been routine from the time it departed Amarillo until it reported over Riverside.

In light of the now known facts concerning the captain's physical condition, there has been much conjecture as to whether he suffered a heart attack in flight. The Board believes that if this had occurred, some indication would have been given in the radio contacts. If the captain made the contacts, he apparently was all right; if they were made by the copilot and something had happened to incapacitate the captain, it would seem very unlikely that no mention would be made of the situation. The normality of these contacts, five of which took place in the one-minute period preceding the accident, leads us to the conclusion that no unusual condition existed in the cockpit. It should be noted, however, that both the captain and the copilot must have been badly fatigued at this stage of the flight. Evidence shows that they arrived at the Kansas City Airport about 0200, Apr. 17, although the flight did not depart until approximately 11½ hours later because of mechanical difficulty.

Copilot Waldron's flight duty time was continuous from the time of departing Kansas City until the accident, approximately 14 hours later.[3] Captain Powell deadheaded from Kansas City to Amarillo, where he took over as pilot in command. Although his actual flight duty time totaled less than seven hours, more than 25 hours had elapsed between the time he and Waldron arrived at the Kansas City Airport and the time of the accident. The amount of rest they might have had during the delay at Kansas City is not known; however, it is known that neither left the airport during that period.

From the time of departure from Phoenix until reporting over Riverside at 6,000 ft., the flight averaged approximately 200 mph. Had this average been maintained beyond Riverside the flight would have arrived in the vicinity of La Habra at approximately 0329, five minutes before the accident occurred. A very unlikely reduction in ground speed to 141 mph. would have been required to bring the flight direct from Riverside to the scene of the accident in the 17-minute interval between reporting over Riverside and the time of the accident. It, therefore, appears more logical to believe that the flight arrived in the La Habra area about 0329 and spent the next five minutes maneuvering in that area at a low altitude. This belief is further substantiated by statements of witnesses who saw and heard a low-flying aircraft in the area a few minutes before the crash occurred.

Since the flight had been instructed by ARTC to maintain 3,000 ft. until passing Downey, its altitude in the vicinity of La Habra (east of Downey) should not have been less than 3,000 ft. It is difficult to explain the flight's being so low in this area, unless the pilot was attempting to make a visual approach beneath the overcast, which, in our opinion, is most likely to have happened. The layer of fog had moved inland to a point approximately 5 mi. east of the

[3] This time greatly exceeds the limitations prescribed under Part 42.48 of the Civil Air Regulations.

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GREER AIRCRAFT ALTERNATOR LOAD BANK, above, is used to test load 120/205, 400 cycle, three phase alternators. Loads can be balanced or unbalanced, resistive or reactive as required. Greer's electrical test stands will check all systems—from 110 volt, single phase to 400 cycle, 3 phase, both A.C. and D.C.

Greer Testers Check Martin 404

Like other aircraft builders, Glenn L. Martin counts on Greer accuracy for precision testing operations

Why do so many aircraft manufacturers, so many airlines, pick Greer test machines for checking crucial components? Is it Greer accuracy? Dependability? Experience? It's all of these, of course, and more. Greer points to an unequalled record for service to the industry; a reputation that guarantees complete satisfaction; a list of customers reading like a "Who's Who" of the aviation world.

Pioneers in test equipment, Greer has more recently aroused industry-wide interest by furthering the standardization of test equipment. A study of the Greer catalog (yours for the asking) will reveal a remarkable selection of standard units for a great variety of testing jobs. Greer's staff of creative engineers is capable of solving any out-of-ordinary requirements.

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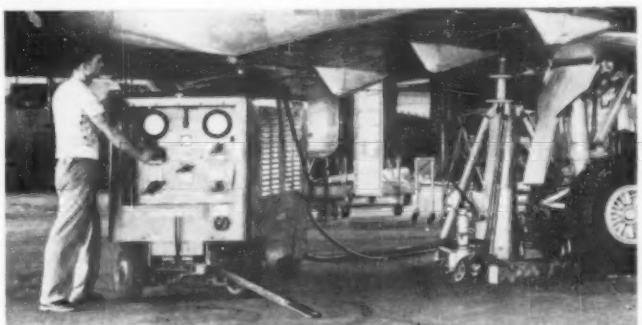

GREER PORTABLE HYDRAULIC TEST MACHINE, above, is shown testing the Martin 404 airliner. This test machine provides hydraulic fluid to 3400 psi pressure and at flow rates to 20 gpm for checking hydraulic system of modern aircraft on flight line. *Photographs courtesy of The Glenn L. Martin Company.*

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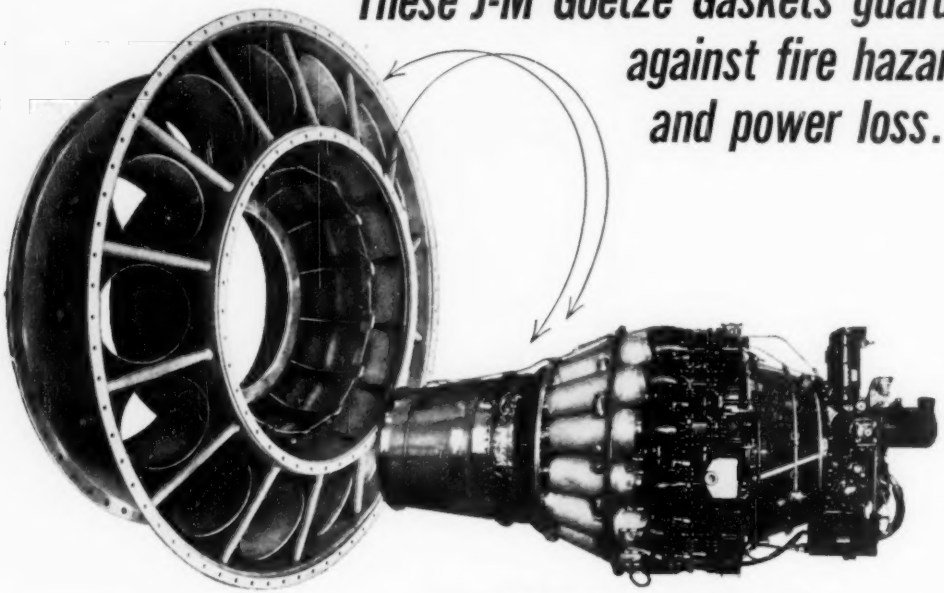
These J-M Goetze Gaskets guard against fire hazard and power loss...



Arrows point to J-M Goetze metallic gaskets on the inner and outer annulus, and their approximate location on the J33 turbojet engine turbine frame.

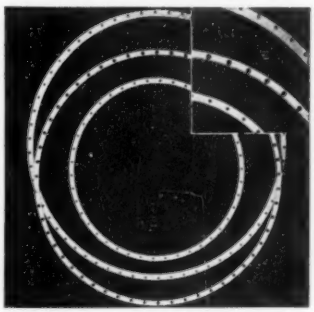
...on powerful turbojet engines like the J33

Sealing the inner and outer annulus on the J33 to prevent leakage of fuel and flame into the airframe is another example of the many tough, critical sealing jobs entrusted to Goetze custom-crafted metallic gaskets.

For this particular service condition, the Goetze gasket specified is made from a flat gasket design... with the metal on both edges rolled around an asbestos filler. This construction provides the resilience needed to overcome the warpage encountered in these applications. Like all Goetze gaskets, this style is precision-made to fit tight and stay tight in service.

There is a Johns-Manville Goetze gasket for practically every jet aircraft requirement. Goetze craftsmen can fabricate them in almost any shape or size for sealing igniters, compressor bleed-offs, cross ignition tubes, combustion chambers, fuel nozzles, turbine drain lines, etc. Backed by more than 60 years of Goetze "know-how," these durable gaskets are solving many of industry's most complex sealing problems.

Why not write for further information about Johns-Manville Goetze gaskets... and other J-M flight-proved products for the aviation industry. Ask for your copy of Brochure AV-1A. Address Johns-Manville, Box 60, New York 16, N. Y. In Canada, 199 Bay Street, Toronto 1, Ontario.



Close-up of J-M Goetze metallic gaskets used as inner and outer annulus gaskets on jet engine turbine frame.

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scene of the accident; east of there, however, the weather was clear. Much of Captain Powell's flying experience had been acquired in the Los Angeles area and he was familiar with the terrain. Only ½ mi. south of the scene of the accident, the terrain is considerably lower, and had the aircraft been in this area, a visual approach might have succeeded. There is no excuse for such an approach to have been attempted, however, in view of the presumed capabilities of the crew and the properly functioning flight and ground facilities available for the ILS approach for which the flight had been cleared.

On Mar. 21, 1952, the Administrator filed a complaint with the Board requesting revocation of the irregular air carrier operating certificate held by Robin Airlines, Inc. On Apr. 18, 1952, after the subject accident, the Administrator imposed an emergency suspension on that certificate and on June 17, 1952, the Board continued the emergency suspension pending final decision in the revocation proceeding.

FINDINGS

On the basis of all available evidence, the Board finds that:

1. The carrier was operating under Air Carrier Operating Certificate No. 6-272, reissued by the Civil Aeronautics Administration on Dec. 18, 1951, to Robin Airlines, Inc.

2. The aircraft was properly certificated, in an airworthy condition, and loaded within its certificated gross weight; it carried ample fuel for continued flight at the time of the accident.

3. Capt. Lewis R. Powell served as command pilot on this flight and on previous ones, contrary to the limitation imposed by his medical certificate, although he was fully aware that this limitation restricted his flying activities to company check pilot duties only.

4. Co-pilot Charles K. Waldron was properly certificated for the flight involved, but during this flight exceeded the flight time limitations prescribed under Section 42.48 of the Civil Air Regulations.

5. The flight was not conducted in accordance with the ARTC approach clearance, in that it descended considerably lower than the minimum altitude prescribed between Riverside range and Downey fan marker.

6. The flight was in clear weather until reaching the Puente Hills, which were clear on the east slope but in fog to the west.

7. Weather conditions at Los Angeles International Airport were satisfactory for the ILS approach for which the flight had been cleared, but were not satisfactory for a visual approach.

PROBABLE CAUSE

The Board determines that the probable cause of this accident was the action of the pilot in voluntarily descending below the minimum altitude for which he was cleared, and attempting an approach at an altitude too low to clear the terrain.

BY THE CAB:

/s/ DONALD W. NYROP
/s/ OSWALD RYAN
/s/ JOSH LEE
/s/ CHAN GURNEY

Joseph P. Adams, Member, did not participate in the adoption of this report.

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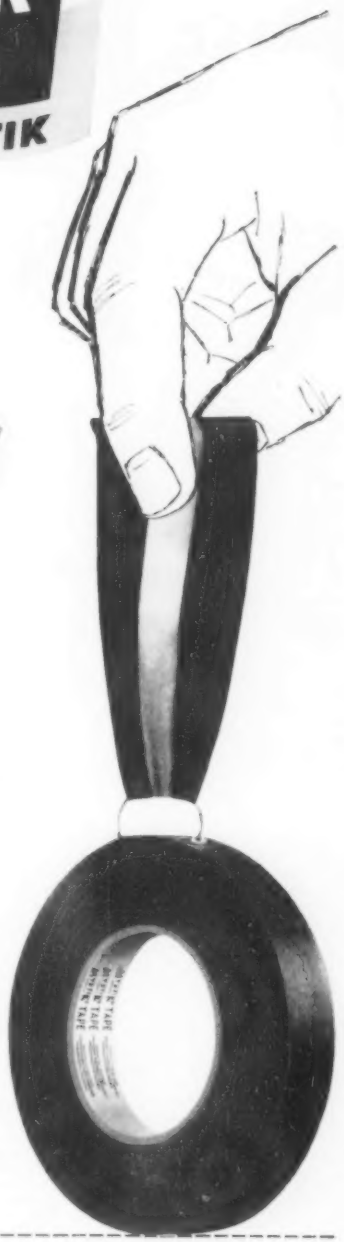

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Type BTR-½ watt. Meets JAN-R-11 Specifications, Filament-type resistance element, extra-Bakelite-sealed against moisture and humidity. Body less than ½" long—3/32" in diameter. Anchored, non-loosening leads. Low operating temperature and high power dissipation. Resistance change less than 1% under 5-hour vibration test. Easily meets rigorous requirements of avionic equipment. Send for full details in Data Bulletin B-1.

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Type DCC—½, 1 and 2 watts—Combines accuracy and economy with high stability, low voltage coefficient, low capacitive and inductive reactance in high frequency applications. Resistance body size 9/16" x 3/32". Excellent for circuits where carbon compositions are unsuitable and wire wound precisions too large or expensive. Designed to meet Signal Corps Specification MIL-R-10509A. Full technical information in Data Bulletin B-7.

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Type MPM—Active resistance section only 3/16" long—body 5/16" x .100". Thin resistance film permanently bonded to solid steatite ceramic rods. Phenolic varnish insulation. Excellent electrical characteristics—low voltage and temperature coefficients of resistance. Power rating—¼ watt at 40°C. ambient. Ask for full details in Data Bulletin F-1.

High Ohmic, High Voltage Resistors with Axial Leads

Type MVX—Body 2" long—¼" diameter. For high voltage applications where high resistance and power are needed. Helical turns of resistance coating provide long, effective resistance path. Low specific-resistance materials assure exceptional stability—even in very high values. Send for complete information in Data Bulletin G-2.

Flat Insulated Wire Wound—Most Adaptable Ever

Type MW—fixed or adjustable. Meets widest variety of design requirements. Low initial and mounting costs. Flexibility in providing taps at low cost. Offers many opportunities for saving space. Unlike most wire wounds, can be operated at full "on-plate" rating without exceeding rated temperature rise of 100°C. Practically impervious to elements. Mounting bracket transfers heat to chassis. Takes overloads of 150% indefinitely with little effect. Write for complete information in Data Bulletin B-2.

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Type FRW—Corresponds to JAN-RW-Types. Depth—½"—Lengths from 2¼". Higher space-power ratio than standard tubular wire wounds. Exceptional mechanical strength, withstands severe vibration. Can be mounted vertically or horizontally. Choice of 2 coatings—to withstand extreme heat or unusually humid atmospheres. Fixed or adjustable. Get particulars in Data Bulletin C-1.

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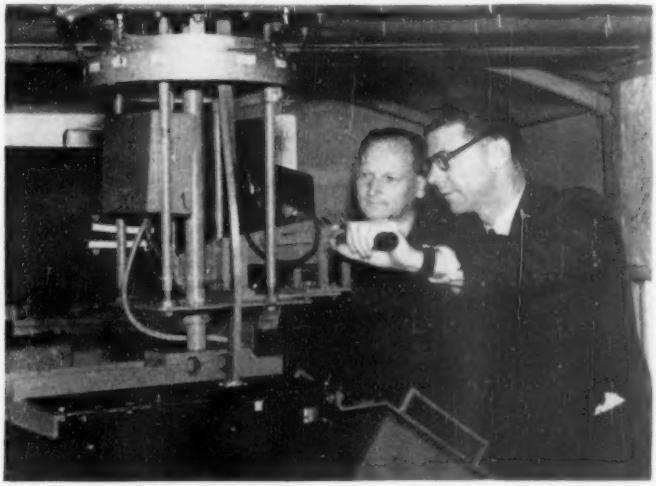

EKCO RADAR is operated by British technician who will accompany unit to U. S.

ANDB to Try 'Poor Man's GCA'

British device may answer need for copter landing aid; uses single antenna radar with radio DF.

By Philip Klass

The Air Navigation Development Board will take delivery this month of a new low-cost British ground-controlled approach radar to evaluate its usefulness as an instrument landing device for helicopters.

The British GCA can be mounted in a small trailer and is designed to permit the direction of its "localizer" and the angle of its "glide-slope" approach paths to be quickly changed. This feature makes the device particularly attractive for military helicopters operating close to the front lines in combat areas.

Army, Marine Corps, Coast Guard, and civilian helicopter operators are expected to follow the ANDB tests closely because of the pressing need for helicopter instrument landing aids. One example of the need: the starting date for the recently inaugurated airport-to-airport helicopter mail service in the New York area had to be delayed because of weather.

▶**Poor Man's GCA**—ANDB has purchased for $15,000 one of four prototype equipments built by E. K. Cole, Ltd. of England. This figure includes spare parts and the services of a British technician who will accompany the equipment. Precision approach radars (PAR) now in use at major U. S. airports cost over $100,000 uninstalled. This explains why the Cole equipment is popularly called "poor man's GCA." The Cole GCA was originally designed for use at low-density airports.

Although ANDB hasn't yet designated a test site for the new radar, selection of a Marine or Army base seems likely because of keen military interest in the problem.

▶**Less Complexity, More Work**—E. K. Cole has been able to slash cost and complexity by ingeniously combining a single-antenna radar with a VHF radio direction finder. This eliminates the two radar antennas used in PAR and cuts radar circuit complexity. For example, the EKCO radar uses less than 50 vacuum tubes. The penalty, however, is that the EKCO design places a heavier work load on the GCA operator.

The direction finder antenna and radar antenna are mounted on a common rotable shaft and oriented so that the center of the radar beam (in azimuth) corresponds to the null position of the DF antenna. When the operator rotates the antennas until the direction finder is aligned on an approaching aircraft, the aircraft will also be centered (approximately) in azimuth in the radar beam. This is the technique used to initially "acquire" the approaching airplane, or helicopter, in azimuth.

To complete the acquisition, the operator then manually tilts the radar antenna in elevation until he gets a maximum signal return (echo) on his radar scope. Once this is done, the approaching aircraft is centered both in azimuth and elevation in the radar beam.

▶**A-Scope Presentation**—The EKCO set gives the operator an A-scope type of radar presentation. The target appears as a small vertical "spike" whose horizontal (X-axis) displacement from the left is determined by the target's distance from the antenna. A scale along the radar scope enables the operator to convert this X-axis displacement into distance in miles.

Because the A-scope doesn't show the plane's azimuth or elevation position (as in PAR scopes), another means must be provided to give the operator the needed talk-down information.

▶**Indicating Lights**—As long as the approaching plane is centered in the radar beam, the azimuth and elevation position of the radar antenna itself is an indication of the airplane's azimuth and elevation position relative to the antenna, and in turn relative to the runway. Four electric switches (two for azimuth antenna position and two for elevation antenna position) operate indicating lights adjoining the radar scope to show whether the plane is on the proper approach path.

If the airplane, and hence the radar antenna, is above the selected approach path, the "fly down" switch will be actuated and its indicating light will be lit. The "fly up," "fly left," and "fly right" lights are actuated similarly. If the plane is on the correct path, all lights are dark. The GCA operator notes his indicating lights, and relays the information to the pilot over conventional VHF communications gear.

The four switches can be relocated relatively easily if it is desired to shift the approach direction or glide-slope angle.

▶**Keeping Plane Centered**—As the airplane's azimuth or elevation position changes, the operator must reposition his radar antenna using the manual controls provided. (EKCO has experimented with foot pedals, handwheels, and bicycle-grip type controls.) The operator must continuously jockey the antenna position in both azimuth and elevation to obtain the greatest return signal, as evidenced by maximum target spike height on the A-scope. A PAR operator, on the other hand, is not burdened with these duties.

ANDB wants to find out whether these additional duties impose a serious handicap on the GCA operator. During

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YOU'LL FIND
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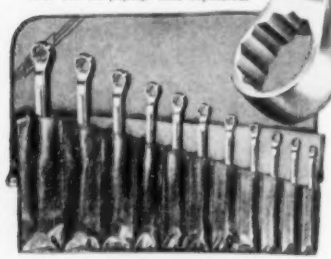
the handiest, safest, fastest wrenches you have ever used

Put *speed* on the job . . . with Snap-on Boxockets . . . far stronger and many times safer than open end or adjustable wrenches! Offset heads provide ample clearance in tight places. Double hexagon openings completely encircle the nut—grip securely on all six corners—cannot slip—cannot spread—and require only half the turning space where movement is limited. Each Boxocket provides two wrench sizes in each handle. Complete series covers full range of sizes, 3/8" to 1 5/8". Other types—Midget, Dwarf, Heavy Duty and Sledge—3/16" to 4 5/8". Write for Industrial Catalog and General Catalog of 4,000 Snap-on tools for production and maintenance.

XV-611-K OFFSET BOXOCKET SET—Consists of 11 wrenches, range 3/8" to 1 1/4", in handy kit bag. Provides 22 wrench sizes with six popular sizes duplicated.



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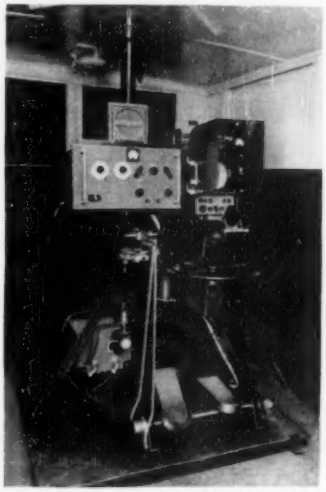
PROTOTYPE EKCO unit shows radar, DF, antennas, operated by . . .



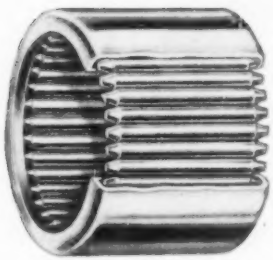
FOOT PEDALS and hand wheel. Radar scope is partly hidden by shield.

a demonstration for ANDB this summer in Britain, a new operator took over the EKCO radar after a short period of instruction and didn't seem overly burdened by his duties, according to an ANDB spokesman who saw the demonstration.

Another potential shortcoming of the EKCO equipment is that the indicating lights don't give the operator or the pilot an indication of how far the aircraft is off the desired approach path. The pilot only knows that he is "on" or "off." He doesn't know how much correction is necessary to get back on the correct path.

Whereas PARs permit the simultaneous talk-down of several aircraft, the British equipment can handle only one airplane at a time, because the

tight quarters are no problem



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Whatever *your* space problem, it will pay you to investigate the combination of high capacity and small OD offered by Torrington Needle Bearings. Our engineers will be glad to assist you.

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It was an ESSO refinery that supplied the gasoline for Orville Wright's historic flight at Kitty Hawk, North Carolina on December 17, 1903. Since then, ESSO Aviation Products have played an ever-increasing part in the advancement of aviation.

In 1944, the first aviation engine test unit, specifically designed to test fuels and lubricants in full-scale aircraft engines, was inaugurated at the ESSO refinery in Bayway, N. J.

Meeting the exacting requirements of modern air transportation, ESSO marketers were also the first to develop and expand the use of the Hydrant Refueling System. Today, even at such widely separated airports as Gander (Canada) and Don Muang (Thailand), the ESSO winged oval guarantees safe, fast, dependable petroleum service to all aircraft.

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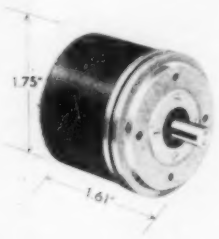
EKCO radar must track the aircraft.

▶ **Radar Highlights**—The EKCO GCA is a low power (10-kw.) X-band (3-cm.) radar. Azimuth and elevation beam width is 3 deg. between half power points. Present PARs have a peak power of 35-40 kw., an azimuth beam width of about 0.8 deg., and an elevation beam width of about 0.5 deg.

With its broader beams and lower power, the EKCO GCA could not be expected to give control as precise as PAR even under optimum conditions.

The EKCO scope has two range scales: 0-5 miles and 0-15 miles.

Bernard Collins, manager of the Southend (England) Airport at which the EKCO equipment was tested in more than 1,000 GCA approaches, will accompany the set to the U.S.



Slidewire Pot

A new tiny slidewire potentiometer capable of rotation through 3,600 deg. (10 revolutions) and with unlimited (zero increment) resolution has been announced by G. M. Giannini & Co. Called the "Spiralpot," the device is available in five standard resistance values between 500 and 2,500 ohms for use in computers or servo systems. Giannini says the pot has "exceptional linearity," will meet operating specs under 10G accelerations, and function at temperatures of −55C to 71C. The device weighs 4 oz. and is said to be capable of withstanding a million revolutions at 200 rpm.

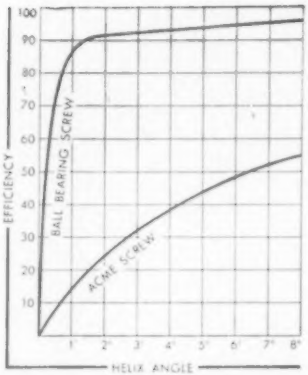
G. M. Giannini & Co., Inc., Pasadena, Calif.

Static Converter

A new static converter for airborne use can supply up to 400 ma. of 300-v. d.c. power from a 115-v. 400-cycle source, its maker, Mercury Electronic Co., announces. Weighing 8¼ lb., the converter is designed to hold output voltage constant within one-third of one percent from zero to full load and for input voltage fluctuations of 105 to 125 v., Mercury says. The unit will operate from −65 to 85C and its material and workmanship meet AN-E-19, according to the maker: Box 450, Red Bank, N. J.

SAGINAW BALL BEARING SCREW JACK UP TO 97% EFFICIENT

IN CONVERSION OF ROTARY TO LINEAR MOTION



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The Saginaw Ball Bearing Screw and Nut offers many important advantages: Lower power to drive the actuator; lightness; higher speed in both directions, with less friction and heat; compactness; and a minimum of maintenance.

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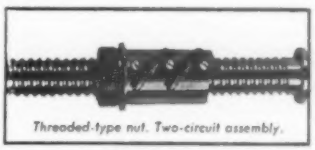
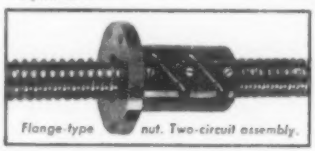
Extensive manufacturing facilities, plus many years of experience, make possible the outstanding high quality for which Saginaw Steering Gear products are famous.

Engineering facilities are complete. Engineers are specialists. The combination can develop a Ball Bearing Screw to meet your specific requirements.



Threaded-type nut. Two-circuit assembly.



Flange-type nut. Two-circuit assembly.

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▶ **Transistor Tetrodes**—By adding another element to the conventional three-element junction-type transistor, Bell Laboratories has upped the transistor's operating frequency by a factor of 10. The new transistor tetrodes have been operated as sine wave oscillators at frequencies higher than 150 mc., L. G. Schimpf of Bell Labs recently told an IRE audience in New York. The fourth element is connected to the transistor base opposite the existing base element and is negatively biased to cause a current to flow between the two base elements. This biasing current lowers the base resistance, cutting electron transit time and thus increasing the usable frequency range.

▶ **GE Gets F-86D For Tests**—USAF has loaned General Electric a North American F-86D interceptor for flight tests at Edwards AFB, Calif. It will be for "further development" of GE's automatic engine control system that goes with the plane's J47-GE-17 engine.

▶ **Britain Tests Sperry ILS**—Sperry's earliest microwave ILS system (2,600 mc.) is currently under test in England with results to date reported as very favorable. Later version, which operates at 5,000 mc. has been evaluated by USAF's All-Weather Flying Division, but final report has not been made public.

▶ **Raytheon Builds Avionics Lab**—Raytheon Mfg. Co. will build a new $2-million laboratory for avionics and radar gear on the edge of Hanscom Airfield in Bedford, Mass. Lab will have 21 specially designed test bays for operating and checking Navy radar equipment.

▶ **Loaded With Avionics**—A new Royal Air Force airplane, unidentified as to type, will have 25 different radio and radar sets on board, according to a recent announcement. The Air Ministry is reported to be spending more on avionics equipment today than it did on aircraft prior to World War II.

▶ **New Technical Bulletins:**

• **Regulated Voltage Supplies** for the laboratory, available in 16 different models with a variety of output voltages ranging from 3 to 1,200 v. are described in new condensed brochure available from Kepco Laboratories, Inc. (131-38 Sanford Ave.; Flushing 55, N. Y.)

• **Ceramic disc capacitors** now available in 40 different types instead of the original 15, are described in the new 1952-53 Aerovox Catalog. Units are available in single, two or three section types. (New Bedford, Mass.) —PK

More Tapered Sheet on the way

By late 1953, wider and longer tapered sheet and plate will be rolling off the huge, new mill at Alcoa's Davenport, Iowa, Works. Leased from the U. S. Air Force, the new mill will produce widths up to 10 feet and lengths up to 33 feet. Thus Alcoa continues its expansion to supply the requirements of our growing aviation industry.

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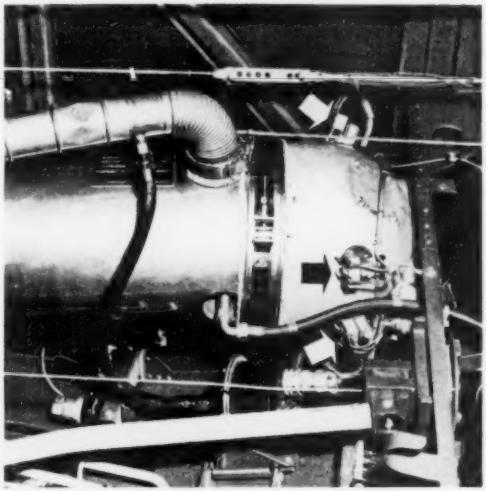
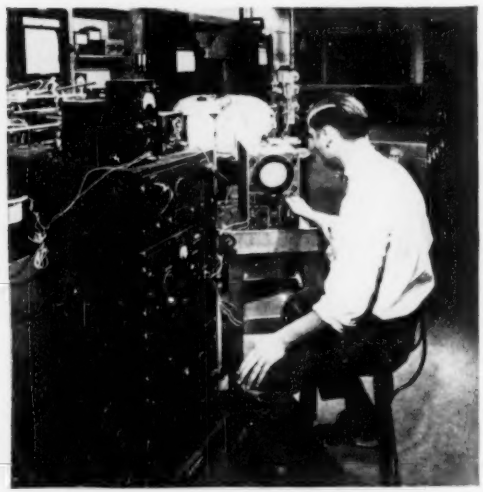
Fenwal heater control used on HUP Helicopter

PIASECKI'S VERSATILE HUP HELICOPTER, here shown rescuing an airman from the sea, serves a number of purposes for the Naval Fleets. Used for anti-submarine patrol training, it also proves invaluable for personnel-cargo transport. It is required to operate under severe climatic conditions. Accurate heat control of the HUP's insulated, sound proofed cabin is maintained by Fenwal THERMOSWITCH® units.



FENWAL THERMOSWITCH UNITS are installed on the HUP's Janitrol heater, shown here. These units help make possible constant, comfortable cabin temperatures for crew and passengers. Over and above their use in aircraft heaters they are also used as safety and control devices in many aircraft applications.



THE VIBRATION test equipment, above, produces the vibration conditions found in helicopters. The test above, on Fenwal Fire and Overheat detectors, is conducted on all types of Fenwal Aircraft Controls and assures vibration proof performance of all Fenwal aviation products.

ENCLOSED ELECTRICAL CONTACTS of a Fenwal THERMOSWITCH control can be seen in this cutaway view. The temperature-sensitive shell expands or contracts *instantly* with temperature changes, thus making or breaking the contacts. Fenwal units are compact, highly resistant to shock, vibration, salt corrosion and extreme temperature conditions. For complete data on these and other Fenwal Aircraft Controls, write FENWAL INCORPORATED, 1212 Pleasant Street, Ashland, Mass.

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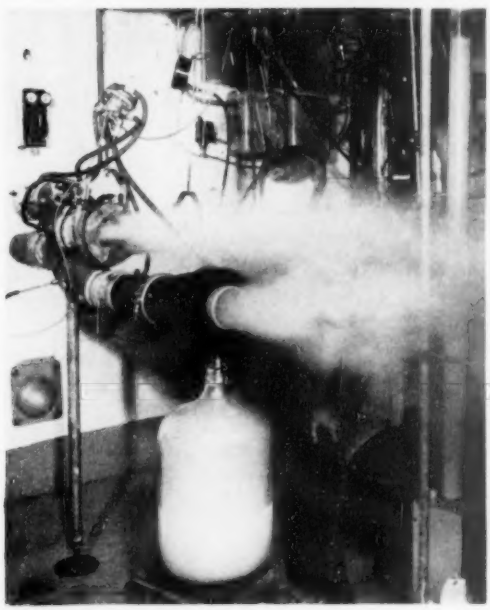

BEFORE Moisture-laden air hides operator when by-pass valve is opened, taking separator out of the circuit.

AFTER With the Stratos separator cut into the lab set-up, 75% of the moisture is removed and drained into the jar.

Separator Spins Water Out of B-47 Air

Stratos centrifugal unit, developed for Boeing, is designed to keep cabins fog-free in fast descents.

By George L. Christian

A centrifugal air moisture separator, first to be used in aircraft, is being manufactured by Stratos division of Fairchild Engine & Airplane Corp. for Boeing Airplane Co.'s B-47 bombers.

Development of the machine, conceived by R. E. Walker of Boeing, was begun as a pure research project at Boeing, since no such article was available on the market. Later the company asked Stratos to continue refinement and to produce the machine.

▶**High Efficiency**—Stratos engineers, who produced the machine at Boeing's request, are proud of its average efficiency of 75% water removal (maximum efficiency of 85% has been obtained). They say these efficiencies are remarkably good in view of the weight, space and pressure drop restrictions imposed on the designers.

Here are Stratos' specs for the MS60-1 separator (capable of handling 60 lb./min. of air): weight, 5.5 lb.; length, 20 in.; maximum diameter, 7.5 in.; inlet and outlet sizes, 4 in.; pressure drop, approximately 4½ in. Hg.

▶**So They May See**—An air moisture separator is almost a must in military jet aircraft. When a B-47 makes a rapid descent from high altitude where it has been chilled, the high moisture content at lower levels may suddenly condense and fog up the cockpit. Condensation on icy windshields obscures view outside the cockpit.

In some cases, pilots have reported fog so thick in the cockpit they couldn't read the instruments and were unable to tell the plane's attitude, altitude or airspeed. Danger of such conditions is great; it is especially critical at low altitudes when aircraft is coming in for a landing.

Another very real problem: when air inlet to the cockpit suddenly spreads fog, pilots may mistake the moisture for smoke. Oxygen masks, standard equipment in jet aircraft, prevent pilots from smelling difference between smoke and fog. In at least one instance a jet fighter pilot yelled to the tower that he was bailing out because his ship was on fire. Later it was ascertained that what he must have seen was fog, not smoke. The bailout occurred at 300 ft., and both pilot and plane were lost.

The machine also removes some of the oil from air entering cockpit or cabin, if engine oil is present. And by keeping cockpit humidity low, less heat is required to defog the windshield.

The Stratos separator may be installed in any position—vertical, horizontal or diagonal—without impairing its operational efficiency, its designers say.

The separator has a disadvantage, according to J. Weiler, Stratos senior research engineer—it reduces the efficiency of the aircraft's air cycle machine (refrigeration system) by building up an average of 4½ in. Hg back pressure.

▶**Engineering Details**—Here is what Stratos engineers did, in conformance with Boeing design requirements, to the Model AE60-2 air cycle machine for

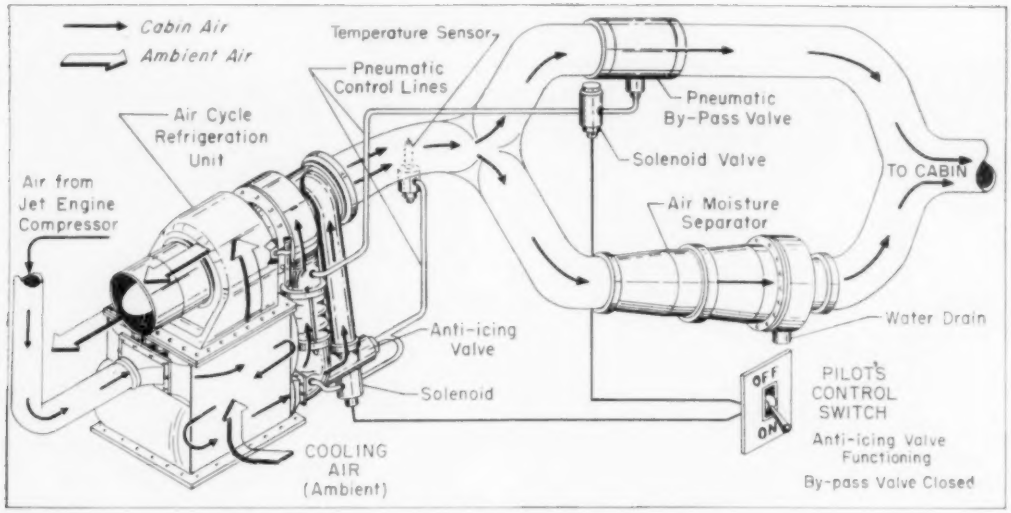

Diagram shows hookup of Stratos air cycle unit and air moisture separator.

which the MS60-1 separator was built as a companion piece:

When the air moisture separator was added to the B-47's air cooling circuitry (between the discharge of the air cycle machine and the air inlet to the cockpit) it became necessary to maintain air cycle machine's discharge air at temperatures above freezing—because the separator will work only with water, not ice. So Stratos modified its air cycle machine to include a thermostatically controlled anti-icing valve. A certain portion of the machine's intercooler air was ducted to the discharge side of the machine's turbine. The thermostat automatically controls the amount of bleed air to maintain a temperature of 35F ± 2 deg. at entry to the moisture separator.

The next step to give the crew maximum cooling was the installation of a by-pass duct incorporating a spring-loaded valve around the separator. When the pilot sees he is flying under atmospheric conditions which are unlikely to produce sudden cabin fog, he can close the anti-icing valve and open the spring-loaded separator by-pass valve by flicking a switch. By-pass is also operated automatically by a barometric switch when the aircraft attains altitudes at which low atmospheric hu-

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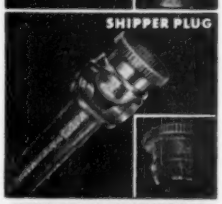
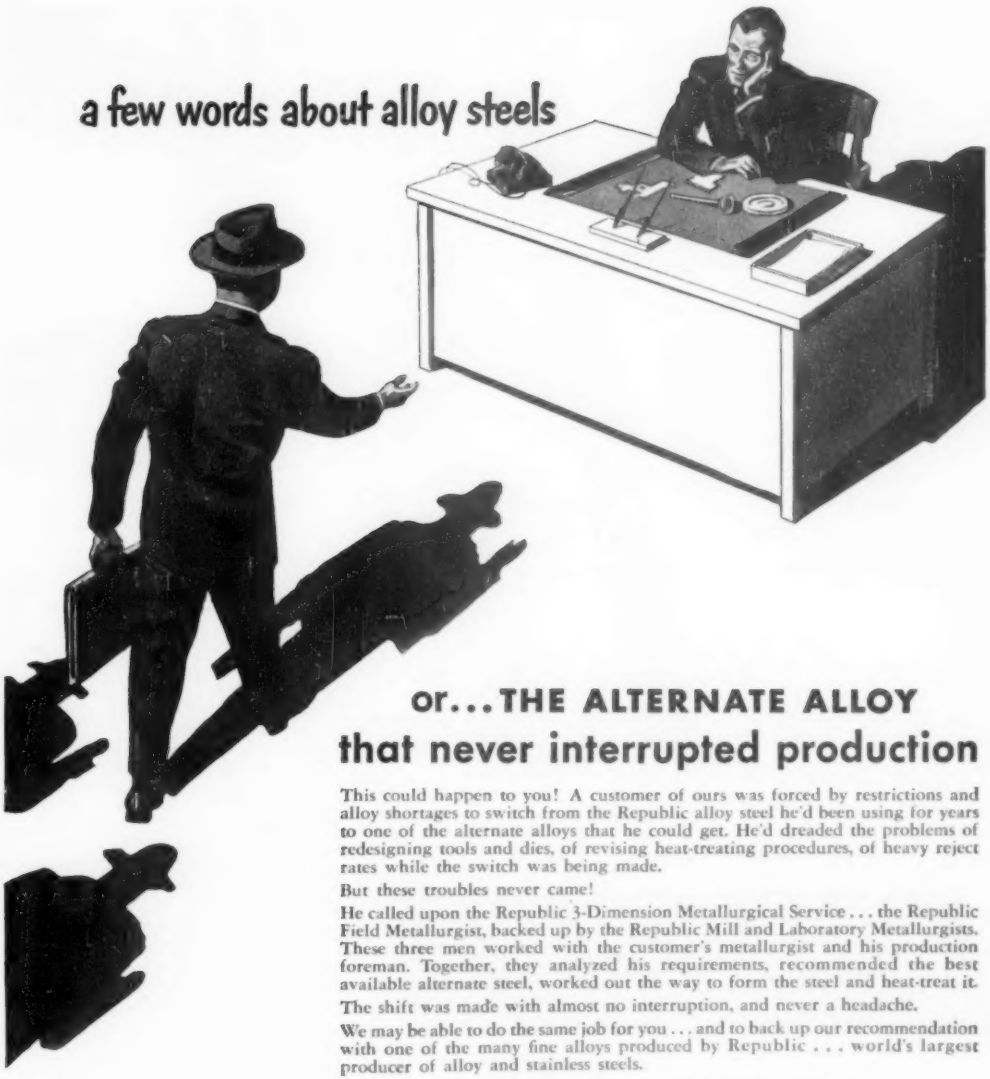


a few words about alloy steels



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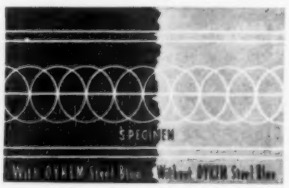
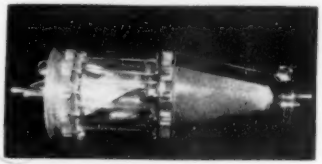


THE DYKEM COMPANY 2303A North 11th St. St. Louis 6, Mo.

STRATOS MS60-1 unit weighs 5.5 lb., can handle 60 lb./min. of air.



PLASTIC MODEL of MS20-1 moisture separator shows working parts.

midity precludes excessive fogging. Maximum cooling is obtained because when anti-icing valve is closed, all air bled from the jet engine goes to the cooling turbine.

When spring-loaded valve is open, the turbine-discharge air by-passes the separator, thus eliminating any appreciable pressure drop. Turbine efficiency is at its maximum then.

The spring-loaded valve also permits pilot to by-pass the separator when airplane operates in dirty or dusty conditions which might plug the separator.

▶ **Inner Design**—The air moisture separator is composed of three major components. Described in order, from air inlet to air outlet, they are:

• **Fog agglomerator.** Conical piece of Orlon fleece collects minute particles of water which would fog up the cabin. They build up in size until differential pressure dislodges them.

• **Rotating assembly** has two parts. The first, a vaned moisture centrifuge, slings large droplets of water, released by the agglomerator, against the outer wall of the separator. Second part, the separator impeller, drives centrifuge in the proper direction. The moisture centrifuge and the driving turbine are mounted on a common shaft. They are fabricated of sheet metal.

• **Drain housing.** Water slung against the separator walls is collected in the drain housing, then piped overboard.

Under supersaturated humidity conditions of 275 grains/lb. of entrained moisture, the machine retains its maximum efficiency and separates approximately 2 lb./min. of water, for a nominal design flow rating of 60 lb./min. of air.

▶ **Easy Overhaul**—Stratos engineers ex-

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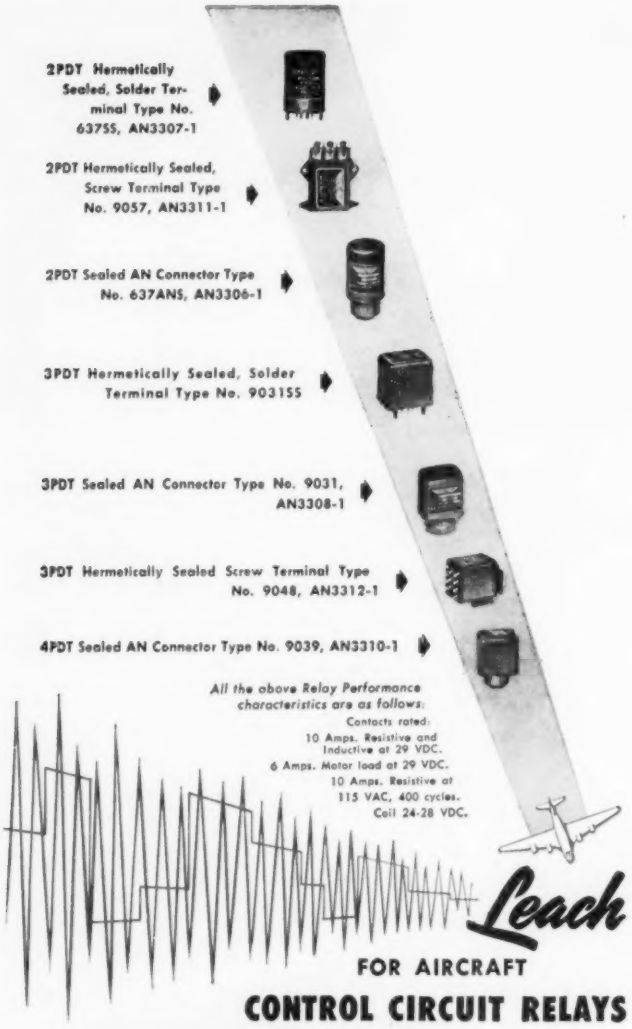
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pect negligible maintenance for the air moisture separator—except for occasional replacement of the agglomerator—because the machine contains only one moving part, its light rotating assembly weighs only 0.7 lb., and its rotating assembly turns at a relatively low speed—average is 4,000 rpm.

▶ **Early Problems**—J. V. Smith, Stratos' assistant to manager of customer relations, cited these problems facing Stratos engineers when they undertook development of the air moisture separator.

Accurate measurement of the moisture content in air is a tricky business. Stratos personnel worked up four independent methods of measuring separator efficiency before deciding which was the most accurate and least susceptible to human error.

Stratos engineers found it difficult to scale the unit to different sizes, and much research was devoted to learning which dimensions were to be controlled. Stratos plans eventually to build a family of separators to cover the complete range of its air cycle machinery.

▶ **Production Plans**—Currently Stratos is in production on the MS60-1 separator.

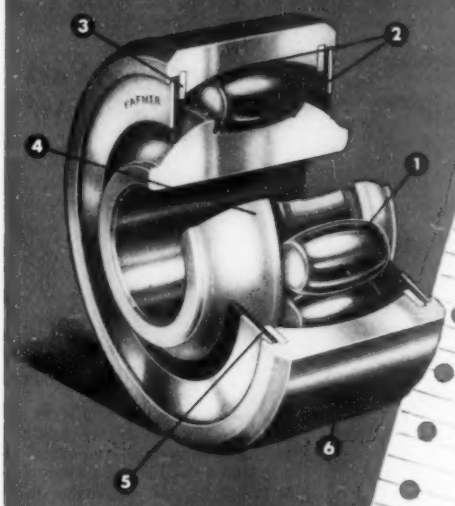
Model MS20 will be next (capacity of 20 lb./min. of air), for fighter aircraft. Basic dimensions are: length, 13.6 in.; maximum diameter, 5 in.; inlet and outlet sizes, 2.5 in. The MS20 should be available early next year.

A third model, MS35, is contemplated. This machine will be 17.5 in. long, have a maximum diameter of 7 in., and inlet and outlet sizes of 3 in.

SLIP-PROOF FOOTING

A new type of rubber matting, perforated and corrugated to insure servicing employes a sure footing on slippery wing surfaces, is in use by Canadian Pacific Airlines. Manufactured of corded rubber, the matting is 7/16 in. thick and comes in rolls 24, 36 and 48 in. wide. Traffic-Tred is made by American Mat Corp., 2213 Adams St., Toledo.

Here it is



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Mobile Units Speed Engine Testing

Two new self-propelled mobile engine testing units that are expected to save 3,800 man-hours a year and cut down noise complaints have been developed by Oakland Aircraft Engine Service and are operating at Oakland, Calif., Municipal Airport. When a third unit, now under construction, is completed, the total cost will be $25,000, considerably less than the minimum cost of a fixed cell.

Assembled on cut-down surplus military buses, the units are equipped with instrumentation for checking engine performance, carry their own fuel load, and can be driven on the highway for work at any point accessible by ordinary vehicles. With quick-change fittings a complete engine change can be made in 45 minutes. Wheels could easily be replaced by half or full tracks, for military

By being able to move away from the congested area of an airport, the units can operate 24 hours a day without disturbing workers by their noise. The mobility of the unit also makes it possible for engines to face into the wind at all times, a help to accurate testing.

The units are adaptable to various types and sizes of engines and can be developed to absorb any horsepower available in the reciprocating engine field. At present, the firm is testing 1,400- and 2,250-hp. engines that power DC-4 and DC-6 commercial airliners.

Similar self-propelled units are in service at Los Angeles International Airport, where Western Air Lines uses a converted school bus; and at Stapleton Field, Denver, Continental Air Lines uses a pair of converted buses.

Plessy Starter Fuel Burns Without Air

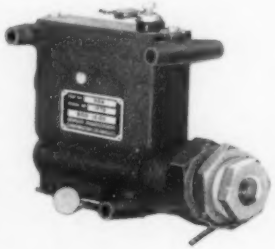
A turbine engine starter, completely independent of external power sources, will shortly be put into production by Hamilton Standard division, United Aircraft Corp.

Built under license from the British Plessy Co., Ltd., the starter is a new mono-propellant liquid-fuel type, first of its kind to be manufactured in this country, according to Ham Standard. The manufacturer adds that Plessy was the first to develop a successful starter using liquid-fuel which burns and produces energy without air.

Starter is operated by a single push-button which causes the fuel to be ignited electrically. Combustion products spin a small turbine whose energy is transmitted to the engine through reduction gearing.

The unit is said to be easy to install, maintain and recharge. It is also light in weight.

Cost per start is low and number of starts is limited only by quantity of special fuel which is stored in the aircraft.



Pressure Switch Has Piston Element

A new piston-type pressure switch, said by its maker to be an improvement over conventional bourdon tube and diaphragm types, has been developed for a variety of aircraft applications by Bobrick Mfg. Corp.

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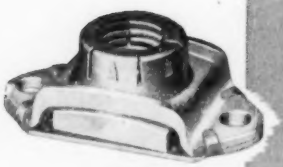

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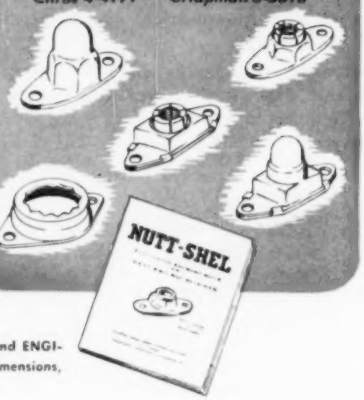

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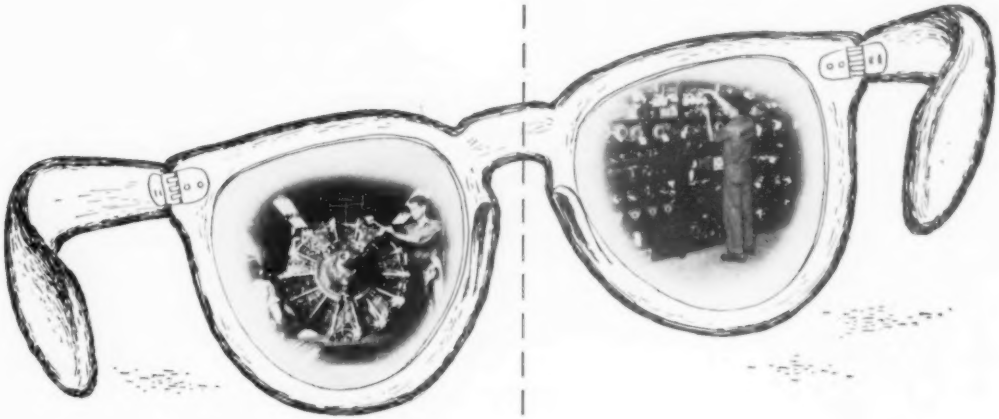
Write on your letterhead for samples and ENGINEERING MANUAL. Manual contains dimensions, tolerances and material specifications.

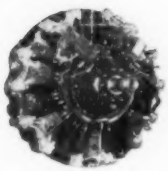
THERE ARE 2 SIDES... TO OUR BUSINESS



SPARE PARTS—FACTORY NEW

Everyone knows the part the Distributor plays in Industry. AIRWORK fills this need with personalized SERVICE. How? By checking your order for accuracy, inserting superseding part numbers, completely accurate information on availability, immediate shipment from stock in most cases and continued follow-up of factory delivery dates. This service coupled with fine cooperation from our manufacturers has resulted in record sales, increasing each month. We distribute for 22 manufacturers.

Are you buying from AIRWORK?



OVERHAUL—EXCHANGE—SALE

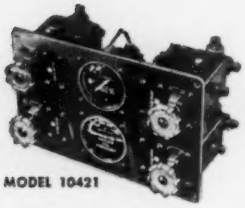
Engines and accessories overhauled by AIRWORK Production lines are setting new records for dependability, extra performance and more economical operation. Pratt and Whitney Aircraft and Continental Motors Corporation approved.

Are you using AIRWORK?

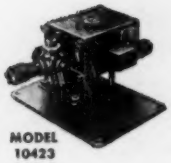
DISTRIBUTORS FOR PRATT & WHITNEY AIRCRAFT

Airwork CORPORATION
MILLVILLE, NEW JERSEY

NEW YORK • MIAMI • WASHINGTON

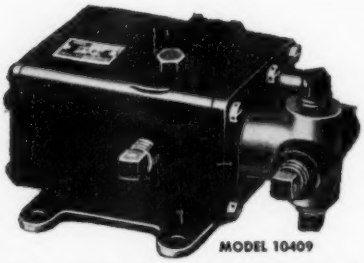


MODEL 10421



MODEL 10423 10412

MODEL 10422



MODEL 10409

MODEL 10410

ARO OXYGEN REGULATORS

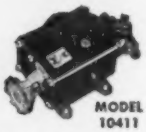
Meet All Aircraft Requirements!

ARO Two-Stage Automatic Continuous-Flow Oxygen Regulators are *precision-made* to provide better performance . . . simplified servicing.

All models are variants of a basic regulator, Model 10409, and will give specified performance on inlet pressures of 50-2000 p.s.i. These models cover all currently known installation requirements. Models can be furnished with output performance according to Civil Aeronautics or Type A-11 specification.

ARO has modern facilities and years of know-how in producing high-precision aircraft products. Adequate facilities for servicing oxygen equipment are as close as your nearest phone. Write or call . . . The Aro Equipment Corporation, Bryan, Ohio.

MODEL 10413



MODEL 10411

MODEL 10416

MODEL 10418

ARO

AIRCRAFT PRODUCTS

Vacuum Pumps, Oxygen Regulators, Air and Oxygen System Accessories

MODEL 10417

MODEL 10419

MODEL 9800

MODEL 10414

MODEL 10424

MODEL 10415

of aluminum die casting and stainless steel, its sensitive operation through the wide range of temperatures encountered in military applications makes it suitable for warning systems, for use in sequencing circuits, in interlocking controls and other critical applications, Bobrick claims. The new switch is adaptable to medium- and high-pressure systems employing hydraulic fluids, water, air or gas, and corrosive mediums, according to the manufacturer.

Gross weight varies from 14 to 16 oz., but envelope size remains the same, the main spring within being the only part that varies to permit operation in any one of eight ranges from 125 to 7,500 lb.

The new pressure switch is infinitely adjustable within any single range. The switch has a low "on-off" differential pressure at all times and a "durable" calibration, maintaining settings under 40G loads.

Bobrick Mfg. Co., 1839 Blake Ave., Los Angeles 39.

OFF THE LINE

A paint that reportedly will resist removal by Skydrol, the Monsanto nonflammable hydraulic fluid, has been developed in Holland. To date, the fluid's paint removal ability has been a minor headache to airlines using Skydrol. A partial solution has been to use a du Pont-developed nylon-base paint—but the cost is high. No price was quoted for the Dutch product, made by Sickens Co., Warmond, Holland.

Douglas Aircraft Co. has authorized Cee-Bee Chemical Co. to use Douglas-developed resealing methods on DC-4 integral fuel tanks. A Douglas technical representative will instruct Cee-Bee personnel in the processes and techniques, using EC-801 material. Douglas says that it also has authorized Cee-Bee to incorporate Douglas tank access door modifications.

Zep Aero and Breathing Equipment Co. announces that it is the first airline oxygen equipment overhaul station to receive Civil Aeronautics Administration approval. The Zep company's headquarters are at Los Angeles International Airport.

Stratos' mass flow valve CFT25-3D has set something of a record. Of the 2,500 units built, not one has ever been returned for service, according to Stratos engineers. The valve is used in Lockheed T-33 jet trainers. Unit also functions as a mixing valve.

Heat Treated Alloy Steel Pin with Malleable Aluminum Collar

REGULAR, CLOSE TOLERANCE AND INTERFERENCE FIT TYPES MANUFACTURED FROM ALLOY STEEL, STAINLESS STEEL AND 75ST ALUMINUM ALLOY

Hi-Shear Rivets of all types—in a full range of sizes are available through Pheoll's extensive manufacturing facilities . . .

NAS 177	100° Countersunk Head
NAS 178	Flat Binding Head
HS 2R7	Close Tolerance 100° Countersunk Head
NAA 2R6	Stud Rivets
HS 11	Brazier Head
HS 23	Close Tolerance 100° Countersunk Head—75ST Aluminum Alloy
HS 26	Flat Binding Head—75ST Aluminum Alloy
HS 27	Close Tolerance 100° Countersunk Head—Close Tolerance Shank
HS 28	Flat Binding Head—Close Tolerance Shank
HS 37	Close Tolerance 100° Countersunk Head—Close Tolerance Shank—Minimum Tensile Strength 160,000 p.s.i.
HS 38	Flat Binding Head—Close Tolerance Shank—Minimum Tensile Strength 160,000 p.s.i.
HS 47	Close Tolerance 100° Countersunk Head—Interference Fit—Minimum Tensile Strength 160,000 p.s.i.
HS 48	Flat Binding Head—Interference Fit—Minimum Tensile Strength 160,000 p.s.i.

Other Types of Hi-Shear Rivets made to customer's specifications. Aluminum Collars for all styles of Hi-Shear Rivets. Also Hi-Shear Rivets for industrial applications.

THE Hi-Shear Rivet consists of a hardened pin and a malleable aluminum collar. Driving may be done from either end. A simple one-piece rivet set is fitted to the conventional rivet gun (or is used as part of the bucking bar), or a pneumatic squeezer may be employed. As the collar is forced into the groove at the end of the pin, a ring of waste material is pinched off and automatically ejected, leaving a smooth low-rounded head.

FREE CATALOG and Engineering Data Sheets, Available on Request.

Time Reducing Features and Advantages

- Adaptable to high-speed riveting of even larger sizes than practical with soft rivets.
- Quick and positive visual inspection. No guess work as to proper installation. Gages or other checking devices not needed.
- No sharp edges or excessive protrusions. Protruding head and collar end are low and smooth.
- Work quickly drawn together. The collar opposes the rivet head and acts as own draw set—automatically draws the work together—instantly—firmly.

PHEOLL MANUFACTURING COMPANY

SCREWS
BOLTS

WRITE FOR YOUR

SOLENOID *Catalog*

IT CONTAINS

helpful data for selecting the *right* solenoid to solve your actuating requirements . . .

+ general information about solenoids . . . covering little known facts you need to know to specify the proper solenoid for your needs.

+ engineering drawings and specifications on most PSP production models. One of these solenoids may meet your needs.

+ specification sheets. You can enter all dimensions and operating requirements yourself, send to us for our recommendations or special design work by our engineers. We believe this solenoid catalog to be the most advanced, most informative, most helpful ever produced. A request on your company letterhead will bring your catalog promptly.

PSP ENGINEERING COMPANY
8420 Otis Street
South Gate, California

Largest manufacturer on the Pacific Coast producing aircraft quality solenoids exclusively.

STOP!
REFUEL WHERE PRICES ARE LOWEST!

Refuel on the eastern seaboard in South Carolina where retail fuel prices are the *lowest* and where airport facilities and service are unexcelled.

MAXIMUM PRICES
80 oct. 31c
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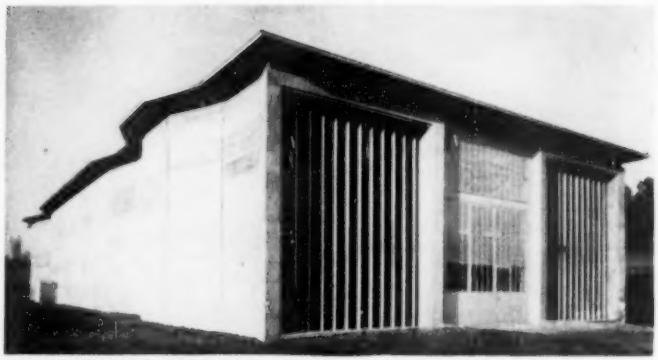
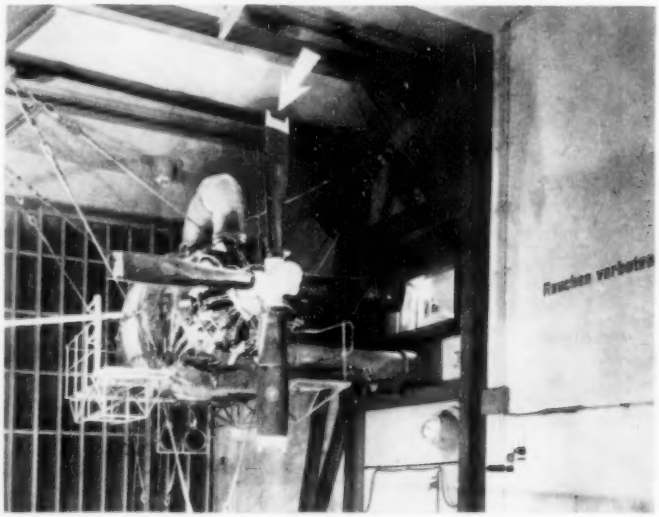
100 oct. 33c

South Carolina — Midway between New York and Miami

SOUTH CAROLINA AERONAUTICS COMMISSION



NEW SWISSAIR building has two engine test cells operated from one control room.



P&W TWIN-WASP engine set up for Swissair test. Note odd propeller tips (arrow).

Swiss Complete New Test Plant

Swissair's new engine test building, completed after four years of planning and construction, incorporates two cells —one for testing reciprocating engines up to 5,000 hp. and the second for gas-turbine engines. Tests are operated from a central control room, separated from the cells by triple-thick glass panes installed for observation.

Here are some highlights of the test rig:

• **Engines** are suspended on rubber-cushioned steel cables to stop vibrations from being transmitted to the building structure.

• **Three** thick panes of glass, spaced 5 in. apart, help keep noise in control room down.

• **Special** instrument in the control room records the slightest trace of metallic particles in engine oil systems.

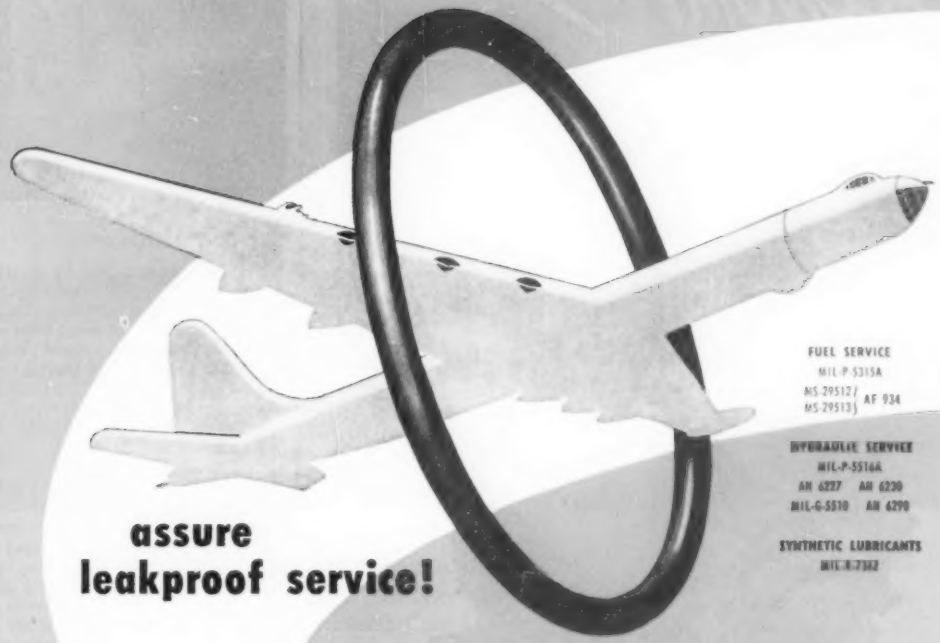
• **Ignition** interlock prevents engines from being started until all conditions for safe operation of the engine have been satisfied. System also automatically shuts engine down in case conditions which might damage the engine arise. Typical examples are rising oil temperatures, low oil pressures and engine overspeed.

The Swissair structure, located at Kloten Airport, Zurich, is 177 ft. long, 66 ft. wide and 25 ft. high. It is thoroughly soundproofed and an efficient air conditioning system supplies 275,000 cu. ft. of air to the control room every four min.

Testing and sound proofing equipment were supplied and erected by two British firms.

PRP "O" RINGS USAF 934 SERIES

Fuel Resistant—approved to MIL-P-5315A



FUEL SERVICE
MIL-P-5315A
MS-29512/
MS-29513 } AF 934

HYDRAULIC SERVICE
MIL-P-5516A
AN 6227 AN 6230
MIL-G-5510 AN 6290

SYNTHETIC LUBRICANTS
MIL-L-7362

assure leakproof service!

Everyone is finding that PRP Fuel Resistant "O" Rings are the best for any type of *Aviation* or *Jet Engine Fuels* (either high or low aromatic content). They retain their resiliency at low temperatures, do not shrink when dried out and are the perfect answer to all fuel sealing problems.

PRP can also furnish AN approved Compounds for use in Hydraulic Fluids, Synthetic Lubricants, to all Aeronautical Materials Standards and Silicone "O" Rings for High Temperature Services.

FREE . . . Send for your copy of our PRP Army-Navy Folder showing complete Specifications, Sizes and Compounds for all Military uses. Write today!

Precision Rubber Products
CORPORATION

The "O" Ring Specialists

Dept. 2, Oakridge Drive, Dayton 7, Ohio

SAFETY plus ECONOMY

with

SMITH-MORRIS

EXHAUST PIPES

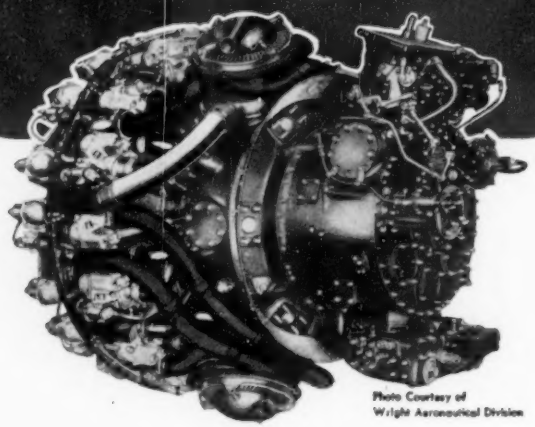


Photo Courtesy of Wright Aeronautical Division

The old saying "A chain is no stronger than its weakest link" might easily be the axiom of aircraft design. No unit of the compound reciprocating engine is more significant for its efficient service than the lowly exhaust pipe.

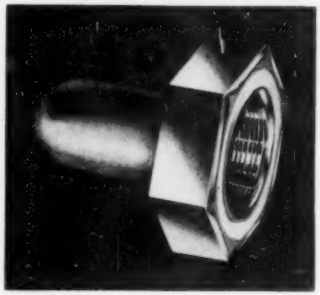
Smith-Morris is proud of its contribution to the success of the Wright Turbo-Cyclone "18". In the field of high temperature sheet metal fabrication Smith-Morris quality assures dependable and trouble-free service. Our experience may offer a solution to your fabrication problem.

SMITH-MORRIS COMPANY

AIRCRAFT EXHAUST MANIFOLD SYSTEMS
GAS TURBINE PARTS AND ASSEMBLIES

FERNDALE 20, MICHIGAN

NEW AVIATION PRODUCTS



Switch Boot

New high-pressure boot for rocket or aircraft switches covers standard toggle switches. Cover, designed to operate through a temperature range from −80 to 500F, includes silicone rubber chemically bonded to a nut. It seals against the action of salt water, acids and ozone.

Automatic and Precision Mfg. Co., 315 E. 91 St., New York 28.

Loop Improves ADF

Higher accuracy and faster response are among the advantages claimed for new Ferro-Dynamic loop being produced by Lear, Inc., for use with radio navigation equipment in executive aircraft. Component is designed for operation with firm's ADF-14 radio compass, and can be modified for use with ADF-12 Orienter. It has ferrite core loop with electrical quadrantal error correction.

Learcal division, Lear, Inc., 11916 W. Pico Blvd., Los Angeles 64.

Obstruction Light

Double obstruction light for placement at airports or along air routes comes from Great Britain's General Electric Co., Ltd. Two specially designed red prismatic glass domes give symmetric light distribution with maximum intensity 10 deg. above horizontal. Body is silicon-aluminum alloy casting. Lamps are 75 watts.

General Electric Co., Ltd., Magnet House, Kingsway, London W. C. 2.

CHICAGO & SOUTHERN, UNITED, and CAPITAL AIRLINES USE SOUTH WIND HEATERS FOR COMFORT ON THE LINE!

NEW mobile aircraft air conditioner by Airtemp brings complete all-weather comfort to airliners with *South Wind* heaters

Complete on-the-ground, all-weather comfort for airline passengers is achieved by this new mobile air conditioner by the Airtemp Construction Corporation.

Airtemp chose Stewart-Warner South Wind Heaters, acknowledged leaders in the field of aircraft heating, for dependable cold weather operation. The heater supplies up to 200,000 BTU's—more than ample, even for arctic operation—direct to the plane's own ventilation system. Stewart-Warner supplies the electric fuel pumps and instruments, as well.

Already chosen by Chicago and Southern Air Lines, United Air Lines and Capital Airlines, the unit is finding ready acceptance by the industry for its dependability and ease of operation. Another example of South Wind leadership.

Left hand panel of truck with engine door open for inspection or service. Drive is direct to compressor. The instrument panel on the right carries Stewart-Warner liquid level and temperature gauges.

A PRODUCT OF SW STEWART-WARNER

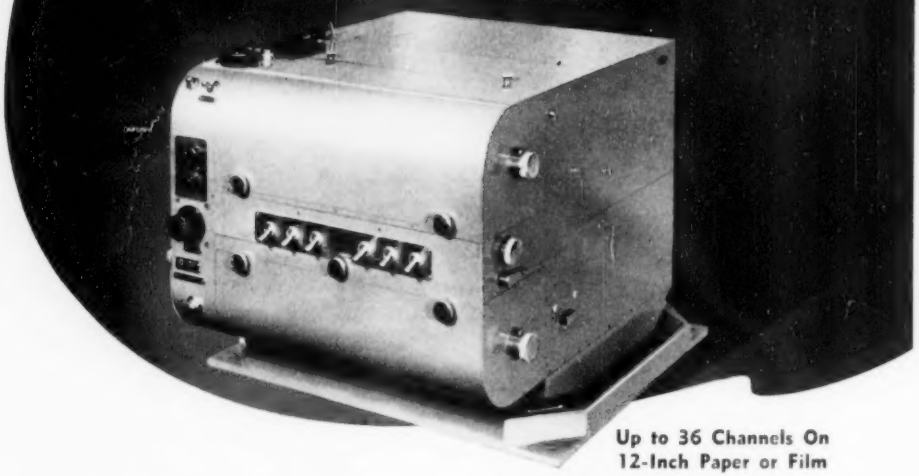
South Wind®

AIRCRAFT HEATING
AND THERMAL
ANTI-ICING EQUIPMENT
INERT GAS GENERATORS

Heater installation. Only the damper control of the heater is visible. The South Wind heater itself is so compact that it fits completely inside the duct, yet supplies up to 200,000 BTU's of heat to cabin and cockpit.

Address inquiries to the South Wind Div., Stewart-Warner Corp., Indianapolis 7, Ind.

for ease of INTERPRETATION and REDUCTION of RECORDED data



Up to 36 Channels On
12-Inch Paper or Film

Midwestern Model 570 Oscillograph

This accurate, rugged instrument was designed for industrial and laboratory testing requiring numerous channels, each of which should have clear definition for accurate reading. It will record up to 36 channels of separate data on paper or film 12 inches wide. Dimensions are: $14\frac{1}{2}$" x 18" x $19\frac{5}{16}$" (including base). Weight is 89 lbs. (including base). For use in this oscillograph Midwestern offers a wide variety of precision galvanometers with undamped natural frequencies up to 3500 cps. Write for complete oscillograph and galvanometer specifications.

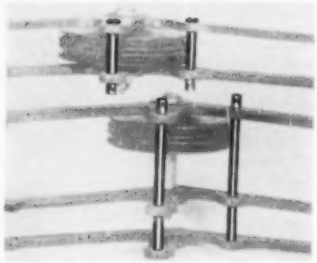
FEATURING . . .

- Two separate daylight-loading magazines for exposed and unexposed recording paper.
- Trace identification (beam interrupter type)
- Precision tuning-fork-controlled electronic timer.
- Graduated external viewing screen.
- Continuously-variable paper speed.
- A wide selection of optional special components.

MIDWESTERN

MIDWESTERN GEOPHYSICAL LABORATORY

3401 S. HARVARD TULSA, OKLAHOMA



Pulley Guard Pin

A new quick disconnect pulley guard pin with National Aircraft Standards approval does away with use of cotter pins. Spring clip on pin depresses while it is being pushed through hole, then snaps out on shoulder of hole to lock pin against vibration.

A. A. Metal Products, Inc., 6200 S. Central Ave., Los Angeles 1.

Plastic for Blower

Plastic scrolls for avionic gear blower motors are said to resist breakage. They are made of Libby-Owens-Ford Glass Co.'s glass-reinforced alkyd molding compound for Electroflow Pumps, Inc., Los Angeles. They serve as exhaust housings for the cooling pumps through temperatures from —55 to 125F. Scrolls are fabricated by Bridges Plastic Products, Los Angeles.

Clearance Training

"Phonograph Records to Practice IFR Clearances" is a set of three 78-rpm. transcriptions designed to help pilots overcome the confusion of tangled airport procedures.

This method provides realistic instruction available anywhere at any time—not just during IFR weather—for the student pilot, maker of the records claims. Old methods have been for the instructor to read hypothetical IFR

THE thin GREY LINE...

WOULD BE thinner STILL—

Between hostile bombers and key strategic areas in the United States stands a thin grey line of all-weather jet interceptors . . . our primary defense against devastation.

This thin grey line would be thinner still were it not for the Lockheed F-94. Combining radar magic and added afterburner power with a proven design, it brought fast mass production in a vital field.

To roam the dusky sky, to seek and destroy the enemy . . . in all weather . . . requires swift performance, the latest electronic equipment and . . . equally important . . . freedom from ice.

A. W. Haydon precision timers help give hot wings to F-94. A specially designed program timer shunts three phase current in sequence through ten electrical heating elements in the leading edges of wing and tail.

This application of specialized A. W. Haydon timing equipment solves the problem of simultaneously achieving constant load distribution and peak heat concentration. Here is efficient de-icing at minimum weight.

A wide range of timing problems in military and civilian aircraft are being solved with precise A. W. Haydon timers, custom designed to your specific requirements.

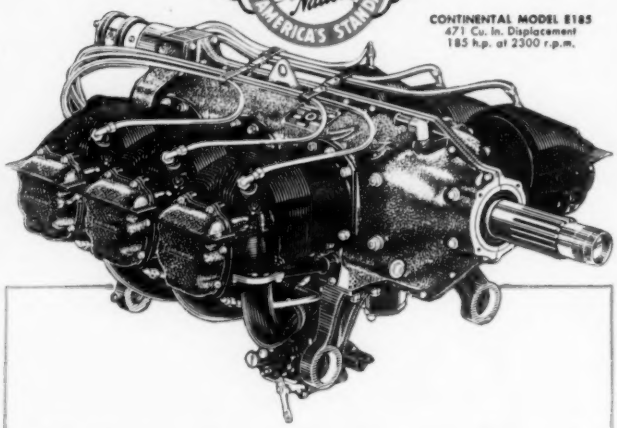
WHEN TIMING POSES A PROBLEM . . . CONSULT THE A. W. HAYDON COMPANY

Write for our latest complete catalog

The A. W. HAYDON COMPANY
222 NORTH ELM STREET
WATERBURY 20, CONNECTICUT
Design and Manufacture of Electrical Timing Devices

CONTINENTAL
AIRCRAFT ENGINES
ARE STANDARD IN MOST OF TODAY'S UTILITY PLANES

CONTINENTAL MOTORS · Powerful as the Nation · AMERICA'S STANDARD



CONTINENTAL MODEL E185
471 Cu. In. Displacement
185 h.p. at 2300 r.p.m.

IT IS a tribute to the quality of Continental engines, as well as to the judgment of corporate and individual owners of utility type planes, that an overwhelming majority of such planes in use today fly with dependable Continental Red Seal power.

REMEMBER, CONTINENTAL BACKS YOU WITH SERVICE WHEREVER YOU FLY

Continental Motors Corporation
Aircraft Engine Division
MUSKEGON, MICHIGAN

clearances to his students, or to wait for bad weather to listen to airport control towers giving actual IFR clearances.

The records contain 25 transcriptions of actual clearances in many cities through the country. The instruction is said to conform to CAA-approved procedures.

Hylan Aircraft Supply Co., Dept. R., Hylan Airport, Henrietta, N. Y.

Scraper Rings

Scraper rings for piston parts in aircraft components are being made to AN 62231 requirements by Gadgets, Inc.

The rings are designed to remove ice, dirt, dust and other foreign matter, preventing excessive wear of O rings and precision parts. They are available in sizes from ¼ to 13 in. inside diameter.

Approved under Spec. MIL-S-5049, the scraper rings, called Super Seals, are said to exceed wear requirements by 300%.

Gadgets, Inc., Dayton, Ohio.

ALSO ON THE MARKET

Hi-tension ignition cable for airborne and ground use is believed first to meet Bureau of Ordnance approval under Spec. MIL-C-3162 as Type 1 Grade C, Class 2. Approval includes Grade A and is in addition to other certifications already received under the MIL spec for cable of this type, a 5-mm. gage consisting of a stainless steel conductor covered with synthetic rubber insulation, a glass-reinforcing braid and over-all low temperature sheath. Cable is made by General Electric Co., Bridgeport, Conn.

Product miscellany: New data sheet describing best means of using temperature-indicating liquid, Tempilaq, and various outside effects on this agent is available from Tempil Corp., 11 W. 25 St., New York. . . . Buyers guide on fire extinguishing equipment and accessories put out by Fyr-Fyter Co., Dayton, contains useful general information. . . . A drafting template to save time when drawing Hi-Shear rivets may be obtained from Hi-Shear Rivet Tool Co., 8924 Bellanca Ave., Los Angeles 45.

A 14-mm. version of the Safir B-57 18-mm. resistor spark plug has been put on the market by the Safir Sales div., U.S. Quarry Tile Co. Labeled the B-70, the plug was designed for and is CAA-approved for Franklin engines, according to the manufacturer. The B-70 is resistant to lead fouling and reduces radio interference, Safir says. Company address: 217 4th St. N.E., Canton, Ohio.

it's a matter of

PRECISION!

The lift, the power, the drive . . . yes, the air-borne heart . . . of the YH-21 Piasecki "WORK-HORSE" Helicopter are delivered by the three transmissions shown here . . . the forward, mid and aft. For *this* kind of component fabrication, the best single manufacturing asset is the PRECISION for which *Steel Products* is famous!

"Precision in Aviation Since 1914"

THE STEEL PRODUCTS ENGINEERING CO.

engineers and manufacturers • Springfield, Ohio

INFORMATION on positions at NORTHROP

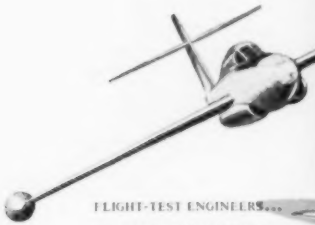
Northrop Aircraft, Inc. is engaged in vitally important projects in scientific and engineering development, in addition to aircraft production. The program is diversified, interesting and long-range. Exceptional opportunities await qualified individuals.

The most responsible positions will go to top-caliber engineers and scientists. However, a number of excellent positions exist for capable, but less experienced, engineers. Some examples of the types of positions now open are:

BOUNDARY LAYER RESEARCH SCIENTISTS...

ELECTRONIC PROJECT ENGINEERS...

ELECTRONIC INSTRUMENTATION ENGINEERS...



FLIGHT-TEST ENGINEERS...

THERMODYNAMICISTS...

SERVO-MECHANISTS...

ELECTRO-MECHANICAL DESIGNERS...

ELECTRICAL INSTALLATION DESIGNERS...

Qualified engineers and scientists who wish to locate permanently in Southern California are invited to write for further information regarding these interesting, long-range positions. Please include an outline of your experience and training.

Allowance for travel expenses.

Address correspondence to Director of Engineering, Northrop Aircraft, Inc. 1003 E. Broadway, Hawthorne, California

The U. S. Air Force's F-89 Scorpion all-weather interceptor combines devastating firepower, advanced electronic equipment and high speed for its vital defense task. Designed and built by Northrop Aircraft's famed engineers and craftsmen, these new aerial destroyers are now on guard in the U. S. air defense system.

NORTHROP AIRCRAFT, INC.

HAWTHORNE, CALIFORNIA

PIONEER BUILDERS OF NIGHT AND ALL-WEATHER FIGHTERS

PNYA Predicts Mass Copter-Commuting

- **Annual traffic by 1975 may exceed 6 million.**
- **Survey shows New York will need 6 heliports.**

Helicopters will be carrying more than 6 million passengers annually in and out of Manhattan by 1975, accounting for more than half the airline traffic at Port of New York Authority's three big terminals at Idlewild, La Guardia and Newark. This great development of transport helicopter service is forecast in a special long-range survey ordered by Port of New York Authority officials.

Approximately 300,000 passengers can be airlifted in 1955 by copters in the metropolitan New York area, the survey predicts, providing there is at least one heliport conveniently located to the Manhattan area.

▶ **Heliports**—At least six heliports will be required in New York area: three in Manhattan (two in midtown, one downtown), the others in Brooklyn, Newark and Staten Island. Another heliport will be required atop the main Post Office building in Manhattan to take care of all-mail copter service. It is estimated that landings and takeoffs from the six passenger heliports will rise from a total of 221 daily in 1955 to 813 daily by 1975.

At the start of passenger-carrying service, operators will face direct operating costs of approximately $0.09 per available seat-mile, or about four times the present level for fixed-wing carriers, because the copters basically will be modified military designs. Later, larger but still intermediate military types will permit lower costs in the $0.06-$0.07 per available seat-mile range.

In 1960-1965, specifically tailored commercial copters will bring available seat-mile costs down to $0.055-$0.06. Seat-mile costs will go down still further with the advent of 30-40 passenger craft capable of operation at $0.045-$0.05 if powered by piston engines and possibly $0.035 with turbine power.

▶ **Folding Rotor Blades**—Basic design problems will include simplification to lower maintenance costs. For operation of restricted-area heliports, as those on rooftops, automatically folding rotor blades will be required.

In order to insure competitive fare levels with shorthaul airlines, trains and buses, copter operators from the start will have to pioneer new operational techniques and service standards, the report points out. They will have to guard against too-ready acceptance of traditional fixed-wing aircraft methods. It is estimated in the study that a minimum of 15% can be saved on copter operations over such shorthaul transportation as local service airlines without much sacrifice.

Fare levels from 1955 to 1960 probably will range from 12-13 cents per revenue-mile, if the operators get mail pay and some government subsidy. This basic rate should go down to 10 cents by 1960 if copter services can maintain indirect costs at 3 cents per passenger-mile. In the following decade, fare might decline to 6.5-7.5 cents per passenger-mile.

▶ **Traffic Patterns**—To capture the huge shorthaul traffic volume that awaits transport helicopter operators in the New York area—more than 25 million people live within 150 mi. of Times Square—highly specialized traffic procedures will have to be developed to maintain timetable performance.

Defined areas will separate fixed-wing and rotary-wing traffic and the latter's pilots will utilize low-powered visual omniranges and distance-measuring equipment, according to the study. Manhattan will be the terminal point for most helicopter services.

This latter factor will encourage growth of so-called aerocab (to-and-

Estimated Annual Helicopter Passengers
New York Metropolitan Area

	Aerocab	Intercity	Suburban	Total
1955	225,000	75,000	.....	300,000
1960	1,177,000	791,000	.....	1,968,000
1965	1,371,000	1,274,000	318,000	2,963,000
1970	1,536,000	1,555,000	1,912,000	5,003,000
1975	1,610,000	1,746,000	3,016,000	6,372,000

Estimated Intercity Helicopter Letter Mail
Both Directions—New York Area

	Domestic, lb. (millions)	Overseas, lb. (millions)	Total, lb. (millions)
1955	0.5	.02	0.5
1960	1.4	.05	1.5
1965	3.4	.12	3.5
1970	5.5	.19	5.7
1975	7.8	.27	8.1

Estimated Helicopter Package Cargo
Both Directions—New York Area

	Total 4th-Class Surface, lb. (millions)	Assumed Diversion to Copter (millions)	Lb. of Package Cargo (millions)
1955	230.44	0.5	1.0
1960	239.17	1.0	2.4
1965	247.92	1.5	3.7
1970	256.70	2.0	5.1
1975	263.90	2.5	6.6

from airport) service. At present more than half of all airline passengers using Idlewild-La Guardia-Newark Airports start or end their trips in Manhattan. During 1952-1975 it is estimated that airline passengers at these airports will increase to approximately 14.8 million. By 1960, according to the study, approximately 25% of the airline passengers who normally would use taxicabs will shift to copter aerocabs and some 10% of limousine users will use copters. At the start, passengers may have to pay fares possibly 70% higher than taxicab tariffs.

▶ **Faster Commuting**—The suburban services generally will be most attractive at the start to executives and other businessmen willing to pay fares some five times the cost of train commutation for a considerable savings in travel time. This travel time is expected to lengthen as more and more businesses continue the exodus from the tightly packed city area further out into neighboring communities. The survey expects that helicopters will cut by 50% travel time to Manhattan from within a 30-175-mi. area.

Helicopters also will take on an imposing portion of the local letter mail and package cargo business. In the 30-175-mi. area surrounding Manhattan, copters will take on approximately 15% of the traffic carried by surface transport by 1975. And it is predicted that by the same date copters will carry a volume of fourth-class mail equal to 2.5% of that carried on the surface.

Indonesia Plans Airline Growth

(McGraw-Hill World News)

Melbourne—High priority has been given to a five-year civil aviation program in Indonesia. Discussions are underway between the Indonesian government and KLM Royal Dutch Airlines covering the status of Garuda Indonesian Airways with a view towards giving the country a larger role in airline development.

Greatest emphasis is to be placed on developing inter-island services and construction of new airports and better communications.

Garuda carries approximately 26,000 passengers monthly on its routes, which extend to Singapore and the Philippines. Some 30% of the carrier's revenue is derived from cargo. Employment now is about 3,700. Its fleet is being expanded to 30 aircraft, 16 Convairs and the remainder de Havilland Herons.

Most of its planes are sent to Australia when they need extensive overhaul or repairs, but there are plans to build up domestic facilities.

Airfreight Needs and Problems

Industry generally finds basic need of:

- Specialized freight terminals.
- Special plane-docking devices.
- Pre-palleting of loads for destinations.
- Conveyors for light loads.
- Specialized vehicles for heavy loads.
- Stronger plane decks.

But they do not yet agree how:

- Passenger lines want combination freight terminals adjoining passenger terminals.
- All-cargo operators want separate freight terminals at airports—but airport managers can't build until the users agree on specifications.
- Flying Tiger wants lift-bed and fork-lift trucks.
- Douglas Aircraft and others recommend docks.
- Port of New York Authority recommends overhead and belt conveyors.
- Freight forwarders want pre-palleting of loads.
- Railway Express Agency wants conveyor belts.
- Military wants pre-packing of even larger loads.
- Passenger airlines say pre-palleting won't work commercially.
- All-cargo lines are in the middle on pre-palleting.
- Airlines want stronger plane decks for heavy loads.
- Manufacturers want gentler vehicles for loading heavy items on plane decks.
- Flying Tiger Line wants plane turntable.
- United likes them but says they jam in winter.
- Whiting Corp. recommends its Load-air dolly equipment.
- Seaboard wants bigger planes, with 75,000 lb. payload.
- Flying Tiger wants planes low to the ground—truck-bed level.
- Douglas Aircraft says freight planes will be conventional.

Airfreight Handling Needs Cited

Air cargo industry would like better ground facilities, but airport operators say carriers must set up specs.

The air cargo industry last week got a few basic answers and a lot of disagreement on solutions to its basic cost problem—lack of specialized freight-handling facilities at airports.

All-cargo operators, combination passenger-cargo lines, freight forwarders, engineers, manufacturers and airport managers—all with ideas on what freight-handling facilities will end the present inefficient hand-to-hand loading system—tried to find the answers at the fourth annual Society of Automotive Engineers Conference on Air Cargo in New York's Hotel Statler.

They argued relative merits of conveyor belts, overhead monorails, mobile equipment and future plane designs like the low-slung Lockheed XC-130 and the detachable-pod concept of the Fairchild XC-120.

▶ **Dock System**—But the simplest and apparently most immediate solution was a dock system proposed by Douglas Aircraft Co.'s equipment engineer—H. O. Olson. The dock would have adjustable tilt from terminal floor to plane deck, similar to but longer than a gangplank. Hinged at the terminal floor edge, the 90-ft. dock stretches straight out to the cargo door of the plane. It is wide enough to accommodate a conveyor extension and for vehicles to maneuver with big loads.

Olson recommends that the terminal end of the dock be about 110 in. high—slightly lower than the Stratofreighter C-97, but even with the C-124, Constellation, DC-6 and DC-4 types, and slightly higher than the C-46 and Fairchild C-119. (Slopes would range from up two degrees for the Stratofreighter to down three degrees for C-46 and C-119.)

On plane design, Olson points out that freight-plane deck levels vary now and probably always will. Furthermore, he said, neither the deck level nor the door location and size have anything to do with solving the basic problem: how to get cargo from terminal to airplane.

Once you have the dock, Olson concludes, materials-handling engineers can tailor the loading means to the loading problem—conveyors for lighter loads, vehicles for heavier items.

The terminal with docks, supported by specific material-handling devices, should allow loading, at a rate of about 1,000 lb. per minute.

The major problem then becomes getting heavy equipment into the plane without damaging the floor.

▶ **Heavy Loads**—Stronger floors and gentler loading devices were both recommended—and probably will evolve.

Conferees noted that Lockheed's new extruded magnesium floor on the 1049B and XC-130 seems a good investment. Flying Tiger Line has installed two such floors already on C-46s, with CAA approval of more than 400 lb. per sq. ft. Olson called for develop-

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ment of a loading vehicle with wide weight distribution. Other panel members noted that new lightweight pallets now coming onto the market have greatly helped prevent floor damage.

▶ **Airport Managers**—Terminals will be built when operators decide on specifications, various airport representatives said.

CAA airports engineering chief Philip A. Hahn led off the discussion of freight terminals by pinpointing the essential problem: Ground-handling, not the terminal interior layout, he said is the "squeaky wheel" of the aviation industry. He said an engineering survey of a typical airfreight operation showed that 85% of in-transit time for goods shipped from New York to Detroit was taken up by ground-handling and only 15% was spent in the air. Even on the New York-Los Angeles route, 67% of the airfreight's time between shipper and receiver is spent on the ground.

CAA economists forecast a threefold growth of air cargo from last year to 1960, Hahn says. By 1955 enplaned cargo will hit 450,000 tons a year and by 1960 it will reach 850,000 tons. Ton-miles will reach 400 million in 1955 and 700 million by 1960.

▶ **International Operator's View**—Seaboard & Western vice president of operations Carl D. Brell presented a paper, "Trans-Atlantic Airfreight Development in Relation to Air Logistics." He said TWA and Pan American's trans-Atlantic passenger fleets "cannot be used to carry large items of freight . . . necessary to support a military force in the field" without extensive modification. Therefore, he said, "The value of the trans-Atlantic airfreight industry to our national defense . . . is in direct proportion to the volume of long-range all-freight capacity it can immediately provide in an emergency to help meet the requirements of the military establishment."

He cited the mobilization priority schedule of Military Air Transport Service, which, Brell states, "has given first . . . preference to the DC-6A, an all-freight aircraft; second priority to the long-range heavy cargo type DC-4; and third priority to the long-range light cargo type DC-4. Combination (passenger) aircraft follow." Yet, he points out, shortage of commercial cargo planes among the airlines is such that the civil mobilization allocation of airliners for emergency MATS duty is 40% DC-4s and only 5% DC-6As. New cargo planes on order are three DC-6As by Pan American and four 1049B Super Constellations by Seaboard. Brell says Seaboard's Super Connies, slated for early 1954 delivery, will have capacity to haul 18 tons per flight across the Atlantic.

Their economy will allow cutting airfreight prices to Europe, "which will make it possible for millions of pounds of additional traffic now moving on the surface to move by air." That increase will lead to buying more DC-6 and Super Constellation freighters, he said, but what is really needed to "generate a constant flow of billions of pounds" is a still bigger and more economical plane. This, he said should be a 75,000-lb.-payload plane with direct operating cost of four cents a ton-mile.

Nonsked Rights to Skeds

(McGraw-Hill World News)

U. S. carriers have been given permission by the Canadian Transport Board to operate nonsked charter services between a number of U. S.-Canadian points covered in their scheduled services.

Included among the carriers are: Pan American World Airways, Seattle-Whitehorse; Western Air Lines, Great Falls, Mont.-Lethbridge and Edmonton, Alta.; Northwest Airlines, Fargo, N. D.-Winnipeg; Northeast Airlines, Boston-Montreal; Colonial Airlines, Washington, D. C.-Montreal-Ottawa, and American Airlines, New York-Toronto.

BRITISH AIRLINERS TEST FIDO

Three different types of British transport aircraft line up on a runway at Blackbushe Airport, Surrey, England, highlighted by the glare of burning gasoline used to dispel low lying mist (Fido). The test was to ascertain pilot and passenger reaction to Fido, used in World War II to raise airport ceilings sufficiently during inclement weather to permit landings and takeoffs. Shown in photo (left to right) are a Vickers Viking, Airspeed Ambassador and an Avro York.

Aviation Safety

Prop Reversal

- **Ham Standard refutes CAB crash findings.**
- **Prop on DC-6 reversed on impact, report says.**

(Editor's Note: For the purpose of throwing additional light on the highly important question of inadvertent propeller reversal, AVIATION WEEK herewith presents an exclusive report on some technical studies of evidence considered, but not accepted, by CAB in arriving at some recent findings. The reports mentioned are in the public files of CAB in Washington.)

Did the No. 3 propeller of the National Airlines DC-6 which crashed at Elizabeth, N. J., last Feb. 11 reverse in flight?

Although Civil Aeronautics Board has issued a report finding that reversal in flight was the principal cause of the accident (AVIATION WEEK Oct. 20, p. 68), this conclusion goes contrary to a little-known technical report submitted to the Board by Hamilton Standard propeller engineers.

The Hamilton Standard report, based on examination of pieces of the No. 3 propeller recovered from the wreckage and simulated tests with identical propeller parts, states that "the only reasonable explanation accounting for all conditions is: that the propeller was in positive pitch position at the time No. 1 blade became fractured" (at the first impact of the plane with the roof of an apartment house into which it plunged).

▶ **Simulate Flight**—The propeller parts report is supplemented by a flight-test report made at Hamilton Standard's request by United Air Lines pilots at San Francisco in a DC-6 in which the No. 3 propeller was reversed in flight in an effort to simulate flight conditions of the Elizabeth accident. The flight-test report also is on file with the Board.

Yet a third interesting technical report bearing on the question of reversal was made by the National Bureau of Standards at CAB's request. From the wording of CAB's accident findings, it is evident that the Bureau of Standards report was used as a partial refutation of conclusions by the Hamilton Standard engineers.

Here is what Tony Evans and R. P. Lambeck, Hamilton Standard engineers, reported:

Examination showed No. 1 and 2 propellers were in positive pitch, No. 3 was in full reverse and No. 4 propeller was at high blade angle with indications it was in full feathered position at the time of impact.

▶ **Further Study Warranted**—Unusual conditions in No. 3 propeller were considered to warrant further study:

- Two impressions on a blade internal contactor switch plate, one light but definite, indicating the blade was in positive low pitch, and the other impression very severe, indicating full reverse pitch. None of the other switch plates showed such marks.
- Impressions on piston sleeve of No. 3 propeller, caused by latching surface of the positive low pitch stop lever, and differing from normal wear marks.
- Low pitch stop wedge of No. 3 propeller showed indications of being slightly cocked from its normal position and had a severe indentation on its surface.
- Shank fracture of No. 1 blade of No. 3 propeller showed under examination that this had been caused by an impact load applied against the leading edge of the blade with blade at a positive angle of about 30 deg.

They conclude that the propeller was forced past the positive low pitch stop by impact (or repeated impacts) indenting the piston sleeve and wedge.

Then the propeller subsequently turned to full reverse pitch, at which point No. 2 and 3 blades became fractured.

They cite recent flight-tests, presum-

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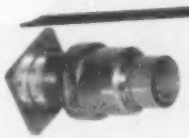

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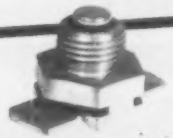

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ably the United Airlines DC-6 tests, showing that at an 83,500-lb. gross load, with METO power on Nos. 1 and 2 engines, No. 3 windmilling and No. 4 feathered, negative rates of climb are obtained at any speed with 20 deg. flaps, and at airspeeds below 140 mph. even with flaps retracted.

A test stand run to determine loads necessary to cause impressions such as were found on the sleeve showed light impressions at 60,000 lb. and deep impressions at 80,000 lb. No impressions were obtained at a loading of 49,800 lb. when the blades were actuated toward reverse, although 46,000 lb. was found to be the maximum load in flight, with overspeed of engine, maximum oil pressure and abnormal pressure surge.

Lambeck and Evans conclude that there is no known manner in which No. 1 blade could have been loaded to produce such a fracture in the course of the crash if the propeller had been in reverse pitch, and the switch plate marks appear to be more than a coincidence with the way the blade was fractured. However, it was not possible to determine from the examination whether the switch plate mark was caused by impact or by wear.

► **Bureau of Standards**—The Bureau of Standards report significantly found that copper from the coating on the piston sleeve was imbedded in three places in the "burr" formed on the sleeve with the steel. The manner in which the copper was imbedded and direction of flow lines indicated a number of blows had formed the burr, the bureau's metallurgists concluded. This conclusion is used by the CAB in its report in refutation of the propeller engineers' findings.

You will remember that the engineers had said the propeller was forced past its positive low pitch stop by impact. Could it have been a series of impacts in rapid succession that would produce such a pattern of layers in the burr on the piston sleeve?

The bureau also examined No. 3 blade of No. 3 propeller, and established that the main direction of tearing in the fractures in the trailing edge of the blade appears to be from the camber to the face side of the blade (indicating it was in reverse at the time of fracture). But CAB asked for no examination of No. 1 blade, so presumably the conclusion that it was in positive low pitch at the time of fracture is uncontested.

The propeller engineers' report, the flight report and the Bureau of Standards report were all available to the CAB at the time it prepared its findings. In the absence of another positive alternate explanation of the crash, the examiners considered the reversal-in-flight pros and cons and decided upon their findings.—A. McS.

SHORTLINES

► **American Society of Travel Agents** urges members to study the new 7% commission recommended by IATA. "It is premature to pass comment" now, ASTA says, but cut on first-class rate from 7½ to 7% is "regrettable." Observers believe ASTA is really satisfied in the overall rate but does not want to stir IATA thoughts of further cuts later.

► **Braniff International Airways** starts Dallas-Chicago DC-4 cargo operation Dec. 15, increasing its "capacity for heavy shipments by 300%." . . . Company revenue passenger-miles the first three quarters gained 21% over a year ago.

► **British Overseas Airways** freight volume on the North Atlantic last summer gained 6% over the same period a year ago, to 550 tons.

► **Civil Aeronautics Board** has rejected United's suggestion that the CAB general fares investigation concentrate on the relationship between standard and coach fares.

► **Las Vegas service** to and from Los Angeles by TWA and United on their through flights should be permitted from now on, CAB examiner W. J. Madden recommends. Western now has exclusive rights to this local traffic.

► **KLM Royal Dutch Airlines** has started a combination standard and coach service Montreal-Curacao. Coach rate: $158.

► **Northwest Airlines'** October load factor was 63%, compared with 71% a year ago. . . . Company has started nonstop Chicago-Seattle coach service with 75-passenger Stratocruisers. . . . NWA cannot commit itself to move its operating and overhaul base to Seattle for some months, due to financial considerations. Improving outlook appears favorable toward the move, but Northwest needs capital to buy new four-engine planes, too.

► **Philippine Air Lines** has Mexican approval of nonstop service San Francisco-Mexico City and plans to use DC-6Bs. No other airline serves this route directly, because of the six-year Mexico-U. S. impasse.

► **Robin Airlines**, which did business also as North Continent, has had its operating certificate revoked by CAB for flagrant safety violations the last two years—including conditions leading up to two major crashes.

► **Trans World Airlines** domestic seat-miles scheduled for December at eight million a day are 40% above the rate a year ago.

► **Western Air Lines** has started construction on a $250,000 hangar at Seattle-Tacoma. . . . Company is starting with Convair service on its new Twin Cities-California route, but plans one-stop DC-6B service next year. TWA and United have filed strong petitions for CAB reconsideration of the new route grant. . . . Western is converting its Convair 240 engines to CB-16 type, at a cost of $175,000. This will increase payload and standardize maintenance with the DC-6B.

► **Wiggins Airways**, slated for abolishment Dec. 31 by a three-to-two vote of CAB, has asked reconsideration on grounds that CAB's own pessimistic traffic estimates can be made to show only a half-subsidy operation if routes are streamlined. Empire, Frontier, Wisconsin-Central and Trans-Texas were renewed with rates higher than that, Wiggins says.

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Dallas, Texas

DIVISION OF UNITED AIRCRAFT CORPORATION

LIST NUMBER ONE

Quantity	Part Number	Mfgr.	Nomenclature	Condition
210	SF14RN-8	Scintilla	Magneto	New
508	SF14LU-10	Bosch	Magneto	Certified or Repairable
107	SF14LN-3	Scintilla	Magneto	New
275	2CM808-4A	Gen. Electric	Generators	New
465	ESA-P/N24502	L-N	Generators	New
2534	P-1	Various	Generators	Repairable
2673	G6-A-(915-4F)	Eclipse	Starters	New
998	G6-(915-4E)	Eclipse	Starters	Repairable
112	TFD-13000-586	Thompson	Pumps	New
68	572-1A	Eclipse	Deicer Pumps	New
171	AN6216-1	Purolater	Filter	New
868,000	MS31 (Ceramic)	B. G. & Auburn	Contacts	New
1,021,530	AN935-10	Garrett	Lock washers	New
72	AN100-A	Unknown	Antenna (VHF)	New
28	G-6-44	Goodyear	34 x 9 wheel	New
9	HRU-28	Homelite	Aux. power units	Overhauled
7	Type 30D-1 & C-2	Lawrence	Aux. power plant	New
18012	7273-9	Lewis Eng.	Thermo. Connector	New
822	369 N-02	Kollsman	Pitot Tube (Sharkfin)	New
337	369N-01 & 010	Kollsman	Pitot Tube (Shafkfin)	New
287	J. H. 1197-4	Jack & Heintz	Gear Box Assem.	New
46	J.H 2300TypeA-4	Jack & Heintz	Energizers	New
34	644255	Sperry	Speed Control Valve	New
7600	SK470-0	Lord	Cowling Vibration Absorber	New
415	1002-1A&2A	Eclipse	Voltage Regulator	Repairable
732	MK4Mod.OB1	Pollak	Bomb Shackles	New
117	551-1-A	Eclipse	Suction Regulator Valve	New
101	31621	P. & W.	Bearing Master Rod	New
6	31E60-6491A-91	Ham. Stand.	Propellor Assem.	New
14,109	AN5831&5838-1	Various	Altitude Computers	New
20,151	6200-085575	Various	True Airspeed Computers	New
747	Navy I-2815(127A)	Edison	Thermometer	New
745	Navy I-2850&I-2865	Edison	Indicator	New
1112	950-R	Jack & Heintz	Starter Motors	New
35	1488-3-3	Hydro-Air	Shut off valve	New
57	TypeD-1Mod 782-Z	Stew. Warner	Portable Heaters	Reconditioned
401	31279	P. & W.	Control Thermo	New
435	31782	P. & W.	Seal (retainer)	New
686	32034	P. & W.	Guide (valve)	New
906	32035	P. & W.	Guide (valve)	New

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Wright 202	Executive	Airline
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RTA-1B Radio Telephone
ARC/R23 Low Frequency Receiver (range)
ARC Type R-15 Tunable Receiver
ARC Type 158 OMNI
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MN-53 3 Light Marker Beacon
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Isolation Amplifier Type F-11 (ARC)

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16	R1820-54 Low total time since new	4	R1820-62 NTSN

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(Many items in this group have not been listed in previous ads.)

Quantity	Part No.	Mfg.	Description
90	36001-0	Eclipse	Compass
11	14601-1F-B1	Eclipse	Gyro Indicator
71	888TY13Z2	Weston	Oil Temp Indicator
40	119862	Weston	Carb. Air Temp Indicator
10	15401-1	Eclipse	Amplifier (PB10)w/ED3 MOUNT
66	10078-1AG	Eclipse	Gyro Indicator
62	CQ-9	Eclipse	Clutch Switch (PB10)
57	MF45-3911-20Z	Vickers	Hydraulic Pump (3000PSI)
327	PF4-713-20BCE	Vickers	Hydraulic Pump
75	1416-19E	Eclipse	Starter
142	28008	Airesearch	Jack (Cowl FLAP)
45	AN4103-2	Clifford	Brass (Valve #U4785) Oil Cooler
120	MF9-713-15A	Vickers	Hydraulic Pump
550	TFD 8600	Thompson	Fuel Booster Pump
125	D7818	Adel	Anti-icer Pump
950	AN4014	Erie Meter	Wobble (D-3) Pump
1000	AN5780-2	G.E.	Wheel & Flap Position Indicator
400	AN5780-2	Weston	Wheel & Flap Position Indicator
115	P4CA2A	Parker	Primer
70	AN3213-1	Scintilla	Ignition Switch
450	A-9 (94-32296)	Nasco	Ignition Switch
90	JH950-R	Jack & Heinz	Starter Motor
53	AN6203-3	Bendix	Accumulator 10"-1500 P.S.I.
140	K14949E	Marquette	Windshield Wiper Kit
188	EYLC-2334	Barber-Colman	Control
11	12086-1C	Eclipse	Amplifier
250	558-1A	Eclipse	Oil Separator
100	716-3A	Eclipse	Generator (NEA-3A)
89	318	Edwards	Horn
230	921-B	Stewart-Warner	Heater (200000 BTU)
97	6041H-146A	Cutler Hammer	Relay (B-12)
22	0655-D	Aro	Oxygen Regulator
65	ASDC2	COX Mfg. Co.	Fire Detector
384	564-2A	Eclipse	Oil Separator

PRATT AND WHITNEY AIRCRAFT ENGINE PARTS

Quantity	Part No.	Description
166	1045A	Bearing
500	3506	Flange
130	8288	Follower Ass'y
814	35814	Blower Ass'y
53	48362	Shaft
75	48363	Shaft
56	48398	Sump
390	48461	Gear
78	76836	Gear
1178	84289	Bearing
113	84487	Housing
77	845916	Nose Housing
200	48350-D	Crankcase Ass'y
200	84083	Cylinder
100	84084	Cylinder
200	84085	Cylinder

CARBURETORS! MAGNETOS! SPARK PLUGS!

Quantity	Part No.	Description
247	PD12K10	Stromberg Injection Carburetor
19	1375F	Holley carburetor
407	SF9LN-2 (manufacturer's part No. 10-12453-6 Spec. AN9511)	Bendix Scintilla Magneto
42	SF5RN-12 (manufacturer's part No. 10-26170-1)	Bendix Scintilla Magneto
185,000	LS4AD1	Spark Plug (Aero)

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236	PR48-A1	Stromberg carburetor

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COCKPIT VIEWPOINT

By Capt. R. C. Robson

Seat Reduction—Only Part of the Story

United Air Lines' recent press release on the aircoach safety findings of Cornell's Crash Injury Research has, to put it mildly, set the industry on its ear. Since both Cornell and UAL are held in high regard, and certainly aircoach safety is an important consideration, this announcement deserves attention.

It may prove to be damaging—even to United, to tell John Q. Public that anytime he sees 79 other persons on board he can figure he's had it. That is quite a statement.

► **The Numbers Game**—If one figures only on a "per exit" basis (which the press release implies is the deciding factor) then Pan American's 82-passenger DC-6B is a lot safer than United's 54-passenger DC-4. Exit-wise these planes, according to my information, seat respectively 7 and 11 people per exit. But numbers alone do not tell the story.

It is impossible, of course, to argue with the thesis that fewer people can be evacuated in less time. But putting 80 persons on an airplane does not in itself produce a dangerous flight, and only in a very special type of accident does evacuation become a factor. For instance, a National DC-4 burned at Philadelphia two years ago and only 19 out of 33 passengers got out. The overriding factors in this case were the antics of the airport fire department and passenger hysteria. Had outside help been available sooner and if the passengers had followed instructions a different story might have been told.

► **License Attendants?**—The matter of cabin attendants is one which always seems to be conveniently ignored. Part of the aircoach ritual is "give 'em as little as possible"—luxuries that is—and this includes using but one crew member in the cabin. One fair maiden versus 80 people—or even 50—seems pretty far out of line for safety. Evacuation under these conditions certainly would pose problems. Even for normal operations—in turbulence, for instance—a ratio of 1 to 40 or thereabouts should be the maximum.

Along with an increase in help, the training of cabin attendants plays a vital part in evacuation. Thank goodness it isn't general practice, but some airlines occasionally use other employes, from the ticket counter, etc., when pinched for a regular flight crew member. Obviously, this person is nothing more than dead weight when an emergency arises.

Perhaps there should be a licensing procedure complete with curriculum and examinations for cabin crew members. After all, everyone else connected with airplanes must pass requirements in order to maintain safety standards.

► **Extend Safety Measures**—Now it may be that United feels that they cannot unload more than 50 or so passengers with their evacuation methods. This is perfectly OK and they are entitled to seat reduction on that basis. It is to be presumed that CIR also made recommendations on how evacuation can be speeded up. It would be a blessing to aviation if United were now to take the lead, follow such recommendations and revise their aircraft in accordance with the crashworthy specifications which Cornell has long championed.

If one chose the right statistics, it probably could be shown that the only flights fit for humans were guided missile cargo operations. But since the airplane—and the coach—seem to be here to stay, I recommend further studies concerning cabin attendants and their training, emergency equipment, crashworthy airplanes and, above all, accident prevention. The conclusion that seat reduction is the only recourse does not seem to be entirely correct.

WHAT'S NEW

Telling the Market

Operating Costs of a Light Aircraft Fleet is a detailed case study of 46 aircraft weighing under 3,200 lb. gross weight with engines from 65-220 hp. The study was made by the University of Illinois during the period Feb. 1, 1949-Feb. 1, 1952 in an effort to recoup the cost of operating these planes, used for faculty and staff charter service. The methods used in determining the costs and results should be of interest to lightplane operators.

Aircraft quality solenoids purposes, uses and design and PSP production models are covered in catalog available from PSP Engineering Co., 8420 Otis St., South Gate, Calif.

Product features and performance data on small high-speed motors, submersible fuel boosters, refueling pump motors and specially designed actuators are covered in **Technical Bulletin 1351** issued by Jack & Heintz, Inc., Cleveland 1, Ohio.

History of the Helicopter, from da Vinci to the present, is outlined in a 16-mm. sound motion picture of 25-min. duration available for viewing by civic, social and school groups by Shell Oil Co. For reservations, write Shell Film Library, 50 W. 50th St., N. Y. 20, N. Y. or 100 Bush St., San Francisco, Calif.

New Addresses

Aviation Insurers Corp., (Avinco), is a new firm handling coverage for private pilots, fixed base operators, corporation aircraft and feeder airlines. Address is 7136 Wisconsin Ave., Bethesda 14, Md. Phone is Oliver 6980.

Rutley Industries, Inc., has been formed to develop tailored chemical compounds for metal working plants. The company is also making a standard line for sounder welding and brazing. Founders are Charles A. Gerber and Arnold A. Tannenbaum. Address is 415 Greenwich St., N. Y. C.

Publications Received

• **Wind-Tunnel Technique**, by R. C. Pankhurst and D. W. Holder, published by Pitman Publishing Corp., 2 W. 45 St., New York 36, N. Y., 1952, $10.00. An account of experimental methods in low-and high-speed windtunnels.

• **World Airline Record**, 1952 Edition, published by Roy R. Roadcap & Associates, 327 So. La Salle St., Chicago 4, Ill., price $12.50. It presents operating, traffic and financial analyses, statistical data through 1951, on regularly scheduled airlines, including Russia's.

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EDITORIAL

The Complexity Problem IV

(Aviation Week continues its series on the important subject of aircraft complexity with this viewpoint from within the Air Research & Development Command of the U. S. Air Force. Brig. Gen. Leighton I. Davis is director of armament in the Office of the Deputy for Development of ARDC. His comments below were delivered before the Cleveland-Akron Section of the Institute of the Aeronautical Sciences, with the title, "The Weapons Systems Concept." They will be concluded next week on this page.—R.H.W.)

By Brig. Gen. Leighton I. Davis

There has, in recent weeks, been a lot of public discussion of the size and complexity of our military aircraft. I have been asked to speak about the "weapons systems" concept. The subject is related to the trend in modern aircraft toward increased size and increased weight of equipment.

Armament, including radar, fire control, and automatic pilots, is receiving some of the blame for the mounting weight. This equipment is obviously necessary to convert the airplane into a weapons system. How well and how efficiently we are accomplishing this task is obviously not a subject for public discussion because the essential factors must remain cloaked in military security.

General Davis

I can assure you, however, that our design problems are being solved by companies such as General Electric, Western Electric, Westinghouse, General Motors; our research is being done by organizations such as Bell Laboratories, Massachusetts Institute of Technology, California Institute of Technology, and others. The Air Force has no arsenals as do the Army and the Navy. The design of this equipment is entrusted to the best brains of the instrument and electronic industry. I believe that if there is an easier and simpler way to meet our military requirements, these top-flight concerns will find it.

Our present armament equipment is the outgrowth of two strong influences:

a. World War II developments—radar, electronic computing devices and automatic control theory.

b. Operational requirements for performance in new regimes of speed, altitude, and range.

Overshadowing these influences is the atomic bomb. It is no wonder that the past few years have produced armament systems that have no resemblance to the equipment used in World War II!

The airframe has been dominated by the availability of jet propulsion making possible supersonic speeds. The low propulsive efficiency of the jet engine necessitates large quantities of fuel to meet military requirements in terms of radius of action. Fuel requirements determine aircraft size more than any factor.

Since World War II our job has been to integrate these developments into a "weapons system." The results of that integration have produced aircraft that are definitely different from the military aircraft of World War II and from the commercial aircraft of the transportation industry.

I have blamed the size of modern aircraft on the low propulsive efficiency of its powerplant. The so-called "complexity"—the radars, the autopilots, and the computers—are a consequence of the atomic bomb. I base this opinion on the fact that the bomb has placed so much power in the hands of the offensive that emphasis has shifted from quantity to quality. Relatively small numbers of quality systems are better than large numbers of airframes deficient in range, speed, and all-weather capability. Great effort must be placed on insuring delivery of a relatively small number of bombs; and on preventing the delivery of bombs on the United States.

The integration of bomb, radars, computers, airframe, engine, and all necessary supporting equipment produces a "weapons system." Balance must be preserved among the components of the whole. Each component must justify its place on the team, and any part that is a weak link or has a difficult task to perform must receive special emphasis, special care in selection, and exhaustive proof tests before adoption.

The performance of the F-86 versus the MiG-15 in Korea proves that the Air Force has placed a well-balanced weapons system against the enemy. Although outnumbered—forced to fight in an unfavorable tactical situation—handing the enemy the advantages of a privileged sanctuary, a "Kings X" zone, as it were, the ratio of MiG-15 kills to F-86 losses continues to climb. The two airplanes are about equal performance-wise; the superlative training given U. S. pilots is about balanced by the tactical advantage and superior numbers of the enemy. Why then the increasingly favorable ratio?

The success of our airplanes depends upon many things. It depends upon the pilots: their eyesight, their judgment, and their training. It depends upon the engine-airframe combinations; especially upon the margin of performance we have over the enemy. Our success depends upon hitting the enemy with bullets, and upon the damage those bullets do once they hit.

Another way of expressing this dependence is to say that the pilot must do four things: **First**, he has to force the enemy into combat; **Second**, he has to close to effective range; **Third**, he has to secure hits; **Fourth**, the hits have to be lethal.

Since these are serial events, the probability of a successful mission is the product of the individual probabilities of successfully accomplishing each step.

$$P_k/_s = P_E \times P_{r_E} \times P_H \times P_k$$

$P_k/_s$ = Probability of a kill per sighting
P_E = Probability of engaging
P_{r_E} = Probability of closing to effective range
P_H = Probability of hitting
P_k = Probability of kills from hits

I'm treating this in a very general way—"lumped" constants, if you will—but the essence of the relationship is that each event is dependent upon the successful accomplishment of its predecessor.

An example may serve to illustrate this interdependence. We all know that hundreds of airplanes are involved in the dog fights in Korea, but only a few are shot down. Our experience is about 2½ MiG-15s per 100 sightings, or one in 40. The relationship might be as follows:

$$1/40 = 1/2 \times 1/5 \times 1/2 \times 1/2$$

In other words, if 50% of the sightings turn into engagements and 20% of the engagements result in the F-86 closing to effective range, and there is a 50% chance of getting hits when in range—and a 50% chance that hits are lethal—the product is 1/40 or 2.5%.

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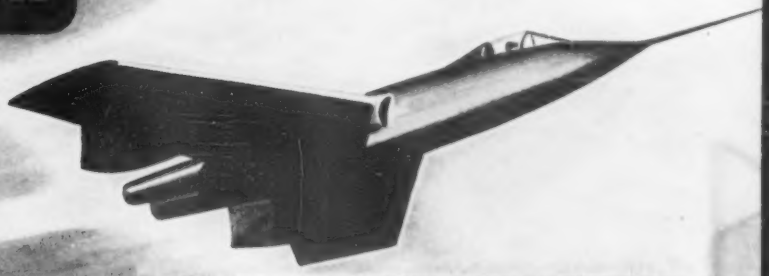

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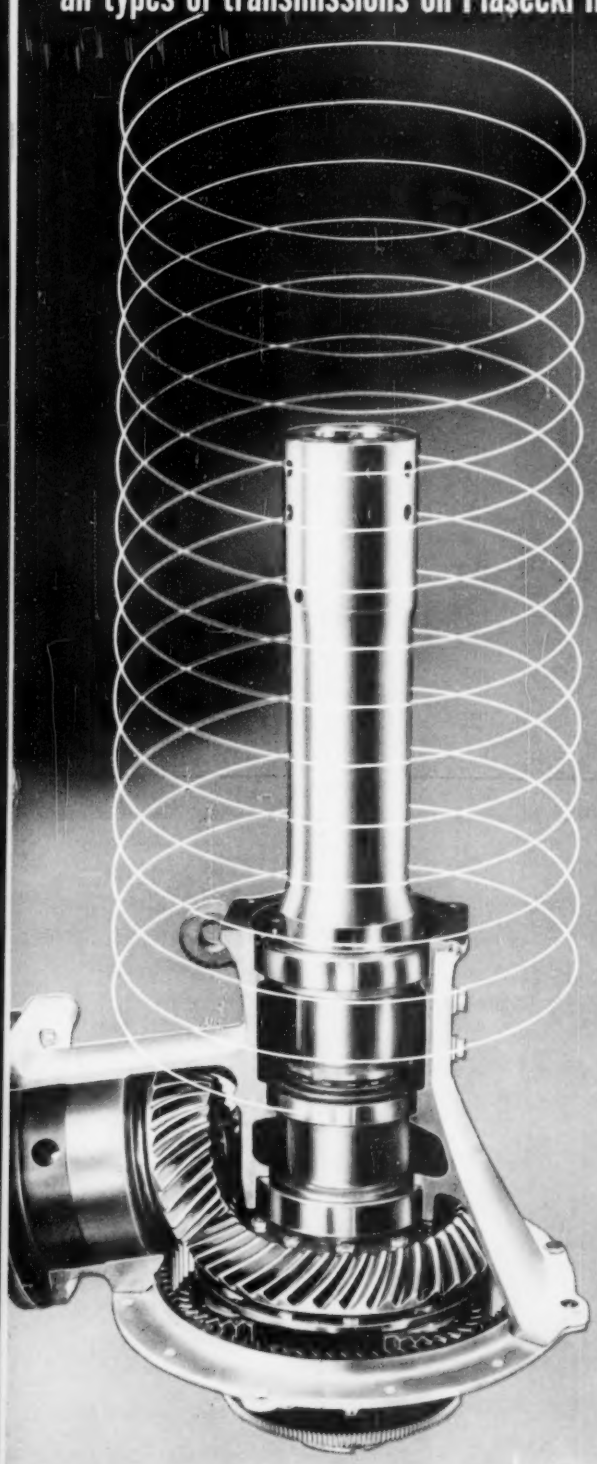

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